5045A

DIGITAL IC TESTER

OPERATING AND SERVICE MANUAL

SERIAL PREFIX: 1932A

This manual applies to Serial Prefix 1932A, unless accompanied by a Manual Change Sheet indicating otherwise.

MANUAL PART NUMBER 05045-90038
Microfiche Part Number 05045-90039

Printed: JUL 1979

HEWLETT PACKARD

CERTIFICATION

Hewlett-Packard Company certifies that this instrument met its published specifications at the time of shipment from the factory. Hewlett-Packard Company further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY AND ASSISTANCE

This Hewlett-Packard product is warranted against defects in materials and workmanship for a period of one year from the date of shipment. Hewlett-Packard will, at its option, repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard, and provided the preventive maintenance procedures in this manual are followed. Repairs necessitated by misuse of the product are not covered by this warranty. NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. HEWLETT-PACKARD IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

If this product is sold as part of a Hewlett-Packard integrated instrument system, the above warranty shall not be applicable, and this product shall be covered only by the system warranty.

Service contracts or customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES (Continued)

SAFETY CONSIDERATIONS

GENERAL

This is a Safety Class I instrument. This instrument has been designed and tested according to IEC Publication 348, "Safety Requirements for Electronic Measuring Apparatus".

OPERATION

BEFORE APPLYING POWER verify that the power transformer primary is matched to the available line voltage and the correct fuse is installed (see Section II, Paragraph 2-6). Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuseholders must be avoided.

SERVICE

Although this instrument has been designed in accordance with international safety standards, this manual contains information, cautions, and warnings which must be followed to ensure safe operation and to retain the instrument in safe condition. Service and adjustments should be performed only by qualified service personnel.

Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible and, when inevitable, should be carried out only by a skilled person who is aware of the hazard involved.

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

CAUTION

Do not turn on the instrument if the pin drivers (A13 thru A24) are installed and A10, 11, 12 (any one) are removed. Damage to the pin drivers may result.

WARNING

IF THIS INSTRUMENT IS TO BE ENERGIZED VIA AN AUTO-TRANSFORMER (FOR VOLTAGE REDUCTION) MAKE SURE THE COMMON TERMINAL IS CONNECTED TO THE EARTHED POLE OF THE POWER SOURCE.

WARNING

BEFORE SWITCHING ON THE INSTRUMENT, THE PROTECTIVE EARTH TERMINALS OF THE INSTRUMENT MUST BE CONNECTED TO THE PROTECTIVE CONDUCTOR OF THE (MAINS) POWER CORD. THE MAINS PLUG SHALL ONLY BE INSERTED IN A SOCKET OUTLET PROVIDED WITH A PROTECTIVE EARTH CONTACT. THE PROTECTIVE ACTION MUST NOT BE NEGATED BY THE USE OF AN EXTENSION CORD (POWER CABLE) WITHOUT A PROTECTIVE CONDUCTOR (GROUNDING).

WARNING

THE SERVICE INFORMATION FOUND IN THIS MANUAL IS OFTEN USED WITH POWER SUPPLIED AND PROTECTIVE COVERS REMOVED FROM THE INSTRUMENT. ENERGY AVAILABLE AT MANY POINTS MAY, IF CONTACTED, RESULT IN PERSONAL INJURY.

CAUTION

BEFORE SWITCHING ON THIS INSTRUMENT:

1. MAKE SURE THE INSTRUMENT IS SET TO THE VOLTAGE OF THE POWER SOURCE.

2. ENSURE THAT ALL DEVICES CONNECTED TO THIS INSTRUMENT ARE CONNECTED TO THE PROTECTIVE (EARTH) GROUND.

3. ENSURE THAT THE LINE POWER (MAINS) PLUG IS CONNECTED TO A THREE-CONDUCTOR LINE POWER OUTLET THAT HAS A PROTECTIVE (EARTH) GROUND. (GROUNDING ONE CONDUCTOR OF A TWO-CONDUCTOR OUTLET IS NOT SUFFICIENT.)

4. MAKE SURE THAT ONLY FUSES WITH THE REQUIRED RATED CURRENT AND OF THE SPECIFIED TYPE (NORMAL BLOW, TIME DELAY, ETC.) ARE USED FOR REPLACEMENT. THE USE OF REPAIRED FUSES AND THE SHORT-CIRCUITING OF FUSE HOLDERS MUST BE AVOIDED.

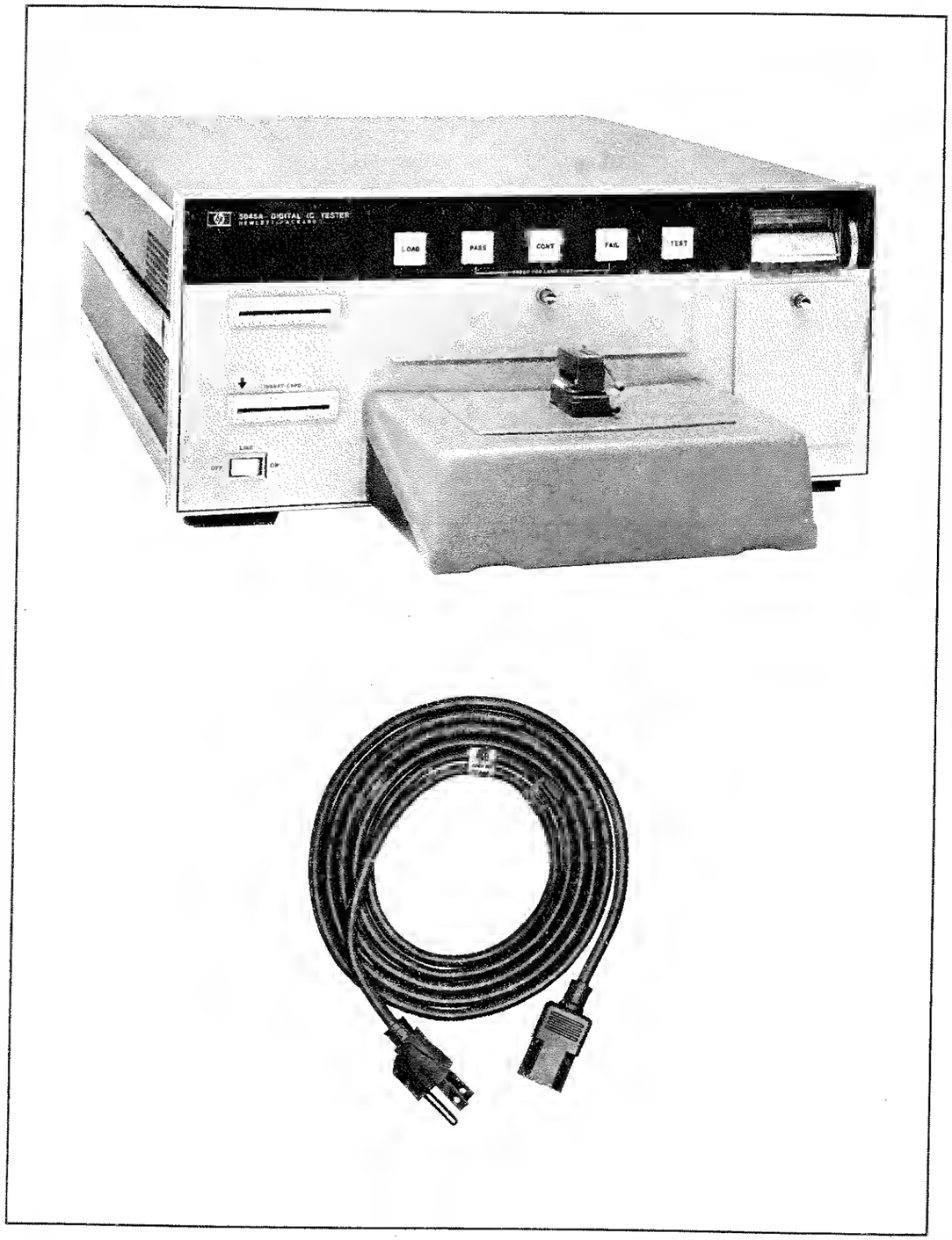


Figure 1-1. Model 5045A Digital IC Tester

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This manual provides operating and service information for the Hewlett-Packard Model 5045A Digital IC Tester. A separate User's Manual also accompanies the instrument to provide a more detailed description of the unit's operating characteristics.

1-3. This manual is divided into eight sections containing the following information:

SECTION I GENERAL INFORMATION covers a description of the tester, options, equipment supplied, accessories available, specifications, and recommended test equipment.

SECTION II INSTALLATION provides instructions for unpacking, inspection, preparation for use, shipment, and storage for the tester. Also covered is the power requirements for the tester.

SECTION III OPERATION covers the basic tester operating features. Describes functions of front-panel controls, programming the tester, printout data, and operator maintenance.

SECTION IV PERFORMANCE TESTS includes a list of recommended test equipment, an in-cabinet performance test and an operational verification test using magnetic cards.

SECTION V ADJUSTMENTS covers the adjustment procedure.

SECTION VI REPLACEABLE PARTS provide a complete list of the tester's replaceable parts and information for ordering parts.

SECTION VII MANUAL CHANGES provide information necessary to backdate the manual to cover earlier instruments.

SECTION VIII SERVICE contains block level theory of operation, schematic diagrams, and component locators.

1-4. DESCRIPTION

1-5. The 5045A DIGITAL IC TESTER performs complete truth table testing on digital IC's contained in standard package form. The unit is compatible with TTL, ECL, CMOS, DTL, RTL, HTL, and associated logic families and is programmed by magnetic cards which contain all test conditions, including test pattern and logic simulation information. Other features include a built-in digital recorder for retrieving failure data, the ability of the tester to "learn" a ROM's output for later transfer to a magnetic card, and the ability to interface with a high-speed handler.

1-6. APPLICATIONS

1-7. Probably the most common type of application for the IC Tester is in-coming inspection of purchased IC's. These parts can be tested manually by hand loading or with the use of a high-speed, automatic handler when large quantities of IC's are involved.

1-8. INSTRUMENT IDENTIFICATION

1-9. Hewlett-Packard instruments have a 2-section, 10-character serial number (0000A00000), which is located on the rear panel. The 4-digit serial prefix identifies instrument changes. If the serial prefix of your instrument differs from that listed on the title page of this manual, there are differences between this manual and your instrument. Instruments having higher serial prefixes are covered with a "Manual Changes" sheet included with this manual. If the change sheet is missing, contact the nearest Hewlett-Packard Sales and Service Office listed at the back of this manual. Instruments having a lower serial prefix than that listed on the title page, are covered in the Manual Changes Section VII.

1-10. EQUIPMENT SUPPLIED

1-11. Table 1-1 lists equipment supplied.

Table 1-1. Equipment Supplied

Description	HP Part Number
Detachable Power Cord 7½ feet (231 cm) long	8120-1378
Head Cleaner Card for Magnetic Card Reader	8660-0463
Resistor Pack (R-Pack) Board	05045-60042
Diagnostic Card Kit	See paragraph 1-14
Dummy IC, 16-pin	05045-80019
Dummy IC, 24-pin (Option 024)	05045-80020
5045A User Manual	05045-90020
Monostable Multivibrator Adapter (20-pin)	05045-60041

1-12. Diagnostic Card Kit, 05045-60120

1-13. The diagnostic kit consists of the following three sets of magnetic cards:

a. A11 Adjustment Check Program Cards

1. DAC REF Check
2. +/-V Zero Adjust
3. DAC V Gain Adjust
4. Current Gen Preset Adjust
5. +/-I Zero 1-2 Adjust

b. Operational Verification Test Program Cards

R-Pack Test Cards:

1. V/I R-Pack 16-Pin
2. V/I R-Pack 24-Pin
3. R-Pack C-Current Modes 16-Pin
4. R-Rack C Current Modes 24-Pin
5. R-Pack Fail Detect Check 16-Pin
6. R-Pack Fail Detect Check 24-Pin

Self-Check Cards:

7. Self Check 1 16-Pin
8. Self Check 1 24-Pin
9. Self Check 2 16-Pin
10. Self Check 2 24-Pin
11. Self Check 3 16-Pin
12. Self Check 3 24-Pin

c. Performance Test Program Cards

1. DAC Adjust Check
2. Analog Voltage Check Part 1
3. Analog Voltage Check Part 2
4. Analog Current Check Low Range
5. Analog Current Check 200 mA Range
6. Pin Driver C-Current Modes 1-8
7. Pin Driver C-Current Modes 9-16
8. Pin Driver C-Current Modes 17-24
9. Cross Talk Part 1
10. Cross Talk Part 2
11. V/I Results Voltage Check 16-Pin
12. V/I Results Voltage Check 24-Pin
13. V/I Results Current Check 16-Pin
14. V/I Results Current Check 24-Pin
15. V/I Offset Check 16-Pin
16. V/I Offset Check 24-Pin
17. Relay Check 16-Pin
18. Relay Check 24-Pin
19. Op Code Check
20. Pos Fast Edge Check
21. Neg Fast Edge Check
22. Printer Check

1-14. ACCESSORIES AVAILABLE

1-15. Operating Accessories

1-16. The 5045A is programmed by prerecorded magnetic cards that are available as accessories. Each card that covers a common type IC is listed in the IC Program Catalog, Part No. 5952-7383. Cards not listed in the program catalog may be programmed at the factory. Contact the factory through your local HP Sales and Service Office (listed at the back of this manual) regarding price and delivery.

1-17. Any card listed in the IC Program Catalog may be ordered directly from the factory by prepaid coupon. When the coupon is received, the order is filled and returned by airmail. The coupons are ordered in books of ten by Model No. 10846A.

1-18. Other accessories available are:

1. Blank magnetic cards (Pass/Fail) ..... P/N 9164-0071
2. Blank Magnetic Cards (Diagnostic) ..... P/N 9164-0072
3. 250 foot roll of thermal paper (minimum order of six rolls) .... P/N 9281-0401
3. Preprogrammed magnetic card for any device listed in the IC PROGRAM CATALOG. The specific cards required are designated on the program card order sheet. ..... Order No. 10845A
4. Coupon book containing ten coupons each redeemable in one preprogrammed magnetic card which is listed in the IC PROGRAM CATALOG. The coupons are mailed directly to the factory and the appropriate program card is returned by mail. The coupons expire two years from the date of receipt... Order No. 10846A

1-19. SERVICE ACCESSORY

1-20. A special Extender Board, part no. 05045-60100 is available for troubleshooting the 5045A. This board plugs into a 44-pin connector in place of a PC board to allow the PC board to be extended for access.

1-21. COMPLEMENTARY EQUIPMENT

1-22. The 5045A is designed to allow high volume testing using automatic IC handlers. The optional interface equipment used to interface the tester to popular makes of automatic handlers is described in paragraph 1-25. The special circuits used to generate the fast rise and fall times necessary in testing digital circuits are contained in the tester's removable test head. This allows the test head to be placed within inches of the IC under test and eliminates ringing, oscillation, and slow rise/fall times problems created by long cables between tester and handler.

1-23. SPECIFICATIONS

1-24. Specifications for the 5045A are listed in Table 1-2.

1-25. OPTIONS

1-26. Several options are available for the 5045A as listed below.

a. **Option 004** International Production Technology (IPT) Interface. This provides a printed-circuit board to replace the standard socket assembly board on the test head and cable to extend the test head. A cable to interface the control signals between the 5045A and the IPT automatic handler is also included. For more information and documentation obtain Installation Note K04-59994A.

b. **Option 005** Symtek Interface. This provides a printed-circuit board to replace the standard socket assembly board on the test head and a cable to extend the test head. A cable to interface the control and indication signals between the 5045A and the Symtek automatic handler is also included. For more information and documentation obtain Installation Note K05-59994A.

c. **Option 006** Daymarc Interface. This provides a printed-circuit board to replace the standard socket assembly board on the test head and a cable to extend the test head. A cable to interface the control and indication signals between the 5045A and the Daymarc automatic handler is also included. For more information and documentation obtain Installation Note K06-59994A.

d. **Option 007** Micro Component Technology Interface. This provides a printed-circuit board to replace the standard socket assembly board on the test head. A cable to interface the control and indication signals between the 5045A and the Micro Component Technology automatic handlers is also included. For more information and documentation obtain Installation Note K07-59994A.

e. **Option 008** Delta Design, Inc. Interface. This provides a printed-circuit board to replace the standard socket assembly board on the test head. A cable to interface the control and indication signals between the 5045A and the Delta Design automatic handler is also included. For more information and documentation obtain Installation Note K08-59994A.

f. **Option 009** Contrel Interface. This provides a printed-circuit board to replace the standard socket assembly board on the test head and a cable to extend the test head. A connector to allow the control and indication signals from the 5045A to be interfaced with the Contrel automatic handler is also included. For more information and documentation obtain Installation Note K03-59994A.

Table 1-2. Specifications

TEST SET-UP METHOD:
Preprogrammed magnetic card. All test conditions including parametric information, input stimuli, and corresponding outputs are contained on the card. The program is verified each time it is loaded.

LOGIC FAMILY COMPATIBILITY:
Compatible with ECL, CMOS, TTL, DTL, HTL, RTL and the associated sub-families. See the IC Program Catalog for available programs.

LOGIC FUNCTION COMPATIBILITY:
Gates, flip-flops, monostable multivibrators, counters, shift registers, priority encoders, Schmitt triggers, parity generators/checkers, decoders/encoders, optical isolators, dual-in-line reed relays, adders, arithmetic logic units, ROM's, PROM's, static RAM's, and many more*.

DUAL TEST FOR EACH IC:
Two test programs (Pass/Fail and Diagnostic) are supplied in the test package for each circuit. Each test is on a separate card. The Pass/Fail and Diagnostic programs are tailored to the testing requirements of the individual Logic Family.

TEST STRUCTURE:
Functional Tests—Truth table is verified by direct comparison between the output of a software generated IC simulator (or stored truth table for certain circuits) and the output of the device under test.
Parametric Tests—All DC parameters (voltages and currents) are tested to the manufacturers' data sheet specifications except where limited by the specifications of the Tester. Test limits are indicated in the information accompanying each magnetic card.
Continuity Test—Verifies pin contact by checking for the presence of current flow into or out of all active pins (failure of this test is shown on the "CONT" indicator).

TEST PATTERN GENERATION:
Test Patterns are derived through algorithmic techniques or from stored truth tables and are individually tailored to each IC.

PASS/FAIL COUNTER:
Prints the number of passed and failed devices. Count is initiated when the magnetic card is inserted.

UNIVERSAL PIN DRIVERS:
Note: The same circuit is used for driving and monitoring a pin whether that pin is an input, output, power supply, or clock. All voltages and currents can be set individually and uniquely on each pin. External test fixtures are not required.

Voltage applied to the device under test:
(Supply Voltage, Input Voltage, and Output Voltage)

Range (15 volts)	Accuracy
−7.5V ≤ to < −1.875V	±25 mV
−1.875V ≤ to ≤ +1.875V	±15 mV
+1.875V < to ≤ +7.5V	±25 mV

Current applied to the device under test:
(Supply Current, Input Current, and Output Current)

Range	Accuracy
−200 mA ≤ to < −2.5 mA	±0.4 mA or ±6%**
−2.5 mA ≤ to ≤ +2.5 mA	±10 μA or ±6%**
+2.5 mA < to ≤ +200 mA	±0.4 mA or ±6%**

Slew Rate: 30 ns/volt

DIGITAL VOLTMETER/MILLIAMMETER FOR FAILED PINS:
Note: When a failure is encountered (with PRINTER: ON, V and I RESULTS: ON), the printing digital Voltmeter/Milliammeter records the voltage and current present on the failed pin(s). In addition, the 5045A reduces the driving parameter which caused the failure (voltage for input pins, current for output pins) until the device no longer fails. The second voltage/current pair is also recorded.

Voltage

Range	Accuracy
−7.5V ≤ to < −1.875V	±35 mV
−1.875V ≤ to ≤ + 1.875V	±15 mV
+1.875V < to ≤ +7.5V	±35 mV

Current

Range	Accuracy
-200 mA ≤ to < −2.5 mA	±0.4 mA or ±6%**
−2.5 mA ≤ to ≤ +2.5 mA	±10 μA or ±6%**
+2.5 mA < to ≤ +200 mA	±0.4 mA or ±6%**

REAR PANEL OUTPUTS:
Automatic Handler Interface: 14 pin Amphenol connector provides "End of Test", "Pass", "Fail" and "Fail Continuity" signals and accepts "Start Test". Also available is a +5V line capable of supplying up to 200 mA.

GENERAL:
Power: 100/120/220/240V (+5%, -10%), 48-66 Hz, 345 VA.
Dimensions: 19 cm high, 42.5 cm wide, 58 cm deep (7.5 in. x 16.7 in. x 22.8 in.).
Shipping Weight: 39.1 kg (86 lbs.)
Net Weight: 27.7 kg (61 lbs)
Operating Temperature: 0°C to 50°C
Relative Humidity: 80%

OPTIONS AND ACCESSORIES:
Option 004†: Interface package for IPT Model 800 Automatic IC Handler
Option 005†: Interface package for Sym-Tek Model 7191ND Automatic IC Handler and other related models
Option 006†: Interface package for Daymarc 952/3 Automatic IC Handler
Option 007†: Interface package for Micro Component Technology Model 2604 and 2608 Automatic IC Handler.
Option 008: Interface package for Delta Model 8040 Ambient Naked DIP Handler.
Option 009: Interface package for Contrel Model H310 Automatic IC Handler.
Option 010: Interface package for PAE Model 3033 HR/LP Naked DIP Handler.
Option 013: Interface package for Trigon T2000 Series Multisize Ambient Test Handler.
Option 024: Expands the capability of the 5045A to 24 pins .
Option 025: Flat-Pack adapter for 14, 16, and 24-pin IC
Option 908: Rack flange kit ,
Option 910: Set of additional product manuals
9164-0071 Blank magnetic program card (Pass/Fail)
9164-0072 Blank magnetic program card (Diagnostic)
9281-0401 250 foot roll of thermal print paper. (minimum order six rolls)
10845A Preprogrammed magnetic card for any device listed in the IC PROGRAM CATALOG. The specific cards required are designated on the program card order sheet.

10846A Coupon book containing ten coupons each redeemable in one preprogrammed magnetic card which is listed in the IC PROGRAM CATALOG. The coupons are mailed directly to the factory and the appropriate program card is returned by mail. The coupons expire two years from the date of receipt.

* *Some circuits require the optional 24 pin capability.*
***Whichever is greater*
† *All interface packages include a test head extender cable, an interface board unique to the particular handler, and a cable to supply the control signals to the handler. This enables the test head electronics to be mounted within inches of the device under test.*

g. **Option 010** Precision Automated Equipment Interface. This provides a printed-circuit board to replace the standard socket assembly board on the test head and a cable to extend the test head. A cable to interface the control and indication signals between the 5045A and the Precision automatic handler is also included. For more information and documentation obtain Installation Note K15-59994A.

h. **Option 013** Trigon Interface. This provides a printed-circuit board to replace the standard socket assembly board on the test head and a cable to extend the test head. A cable to interface the control and indication signals between the 5045A and the Trigon automatic handler is also included. For more information obtain Installation Note K14-59994A.

i. **Option 024** 24-Pin Test Capability. This provides the required circuits to test 24-pin integrated circuits.

j. **Option 025** Flat-Pack Adapter. This provides connector adapters for testing flat package integrated circuits.

k. **Option 908** Rack Flange Kit Part No. 5060-8741. This provides the required hardware to rack mount the 5045A IC Tester.

l. **Option 910.** This provides an extra set of product manuals.

m. **K19-59994A.** Teledyne TAC Interface. This provides a cable to extended the test head. The test head is then connected to the handler. A cable to interface the control signals between the 5045A and the Teledyne automatic handler is also included. For more information and documentation obtain Installation Note K19-59994A.

1-27. RECOMMENDED TEST EQUIPMENT

1-28. Test equipment recommended for testing, calibration, and repair of the 5045A is listed in Table 1-3.

Table 1-3. Recommended Test Equipment

Instrument	Required Characteristics	Recommended Type
Oscilloscope	50 MHz	HP 1707B
Vertical	50 mV/div Sens >S ns rise time	HP 1707B
Horizontal	10 ns/div bandwidth	HP 1707B
Logic State Analyzer	8 MHz, 12 channel	HP 1601L
TTL Trigger Probe	8 MHz, 4 channel w/inverting inputs	HP 10250A
TTL Logic Probe	Bad Level Detect, 10 MHz bandwidth, 10 ns pulse detect	HP 545A
TTL Logic Pulser	1 μs pulse width TTL levels	HP 546A
Voltmeter, Digital DC	±20V, 4-1/2 digit	HP 3465
Ammeter, Digital DC	5 μA -100 ms, .5% accuracy	HP 3465
Power Supply DC	0-10VDC, 0-1A, current limiting	6214A

SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. This section contains information for unpacking, inspection, storage, and installation. Field installation of optional equipment is included.

2-3. UNPACKING AND INSPECTION

2-4. If the shipping carton is damaged, inspect the tester for visible damage (scratches, dents, etc.). If the tester is damaged, notify the carrier and the nearest Hewlett-Packard Sales and 5ervice Office immediately (offices are listed at the back of this manual). Keep the shipping carton and packing material for the carrier's inspection. The Hewlett-Packard 5ales and and 5ervice Office will arrange for repair or replacement of your instrument without waiting for the claim against the carrier to be settled.

2-5. INSTALLATION REQUIREMENTS

CAUTION

BEFORE CONNECTING THE INSTRUMENT TO AC POWER LINES, BE SURE THAT THE VOLTAGE SELECTOR IS PROPERLY POSITION AS DESCRIBED BELOW.

2-6. LINE VOLTAGE REQUIREMENT5. The 5045A is equipped with a power module that contains a printed-circuit line voltage selector to select 100, 120, 220, or 240-volt ac operation. Before applying power, the pc selector must be set to the correct position and the correct fuse must be installed as described below.

2-7. Power line connections are selected by the position of the plug-in circuit card in the module. When the card is plugged into the module, the only visible markings on the card indicate the line voltage to be used. The correct value of line fuse, with a 250 volt rating, must be installed after the card is inserted. This instrument uses a 3AT fuse (HP Part No. 2110-0003) for 100/120 volt operation; a 1.5AT fuse (HP Part No. 2110-0043) for 220/240 volt operation.

2-8. To convert from one line voltage to another, the power cord must be disconnected from the power module before the sliding window covering the fuse and card compartment can be moved to expose the fuse and circuit card.

2-9. Pull on the fuse lever to remove the fuse and then pull the card out of the module. The fuse lever must be held to one side to extract and insert the card. Insert the card so the marking that agrees with the line voltage to be used is visible.

2-10. Return fuse lever to normal position, insert correct fuse, slide plastic window over the compartment, and connect the power cord to complete the conversion.

2-11. Power Cables

WARNING

TO PROTECT OPERATING AND SERVICING PERSONNEL, THIS INSTRUMENT IS EQUIPPED WITH A THREE-PIN POWER RECEPTACLE. THE CENTER PIN OF THE RECEPTACLE CONNECTS THE INSTRUMENT CHASSIS AND PANELS TO EARTH GROUND WHEN USED WITH A PROPERLY WIRED THREE-CONDUCTOR OUTLET AND POWER CABLE. IMPROPERLY GROUNDED EQUIPMENT CAN RESULT IN HAZARDOUS POTENTIALS BETWEEN EQUIPMENT.

2-12. LINE FREQUENCY REQUIREMENTS. The tester operates at line frequencies between 48 Hz and 66 Hz.

2-13. THREE-CONDUCTOR POWER CABLE. To protect the operator, the tester uses a grounded three-conductor detachable power cable shown in Figure 2-1. The male connector end is a NEMA type connector, and the female connector end is a C.E.E. type connector that mates with the 5045A rear panel power connector. Connect the power cable to a power source receptacle with a NEMA grounded third conductor. If the line power receptacle is a standard two-pin type instead of the NEMA three-pin receptacle, use a two-to-three pin adaptor (HP Part No. 1251-0048) and connect the green pigtail on the adaptor to ground.

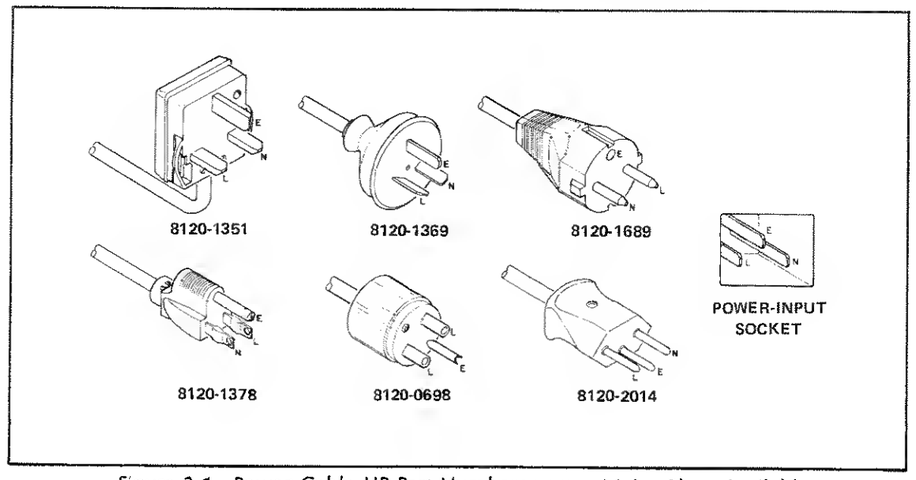


Figure 2-1. Power Cable HP Part Numbers versus Mains Plugs Available

2-14. REPACKING FOR SHIPMENT

2-15. If it becomes necessary to reship the tester, good commercial packing should be used. Contract packaging companies in many cities can provide dependable custom packaging on short notice. Instruments should be packed securely in a strong corrugated container (350 lb./sq. in. bursting test) with suitable filler pads between the instrument and container. *The 4-corner support is not adequate, tester must also have center support.* Before returning instruments to Hewlett-Packard, contact the nearest Hewlett-Packard Sales and Service Office for instructions.

2-16. ENVIRONMENT DURING STORAGE AND SHIPMENT

2-17. Conditions during storage and shipment should normally be limited as follows:

a. Maximum altitude: 25,000 feet.
b. Minimum temperature: -40°F (-40°C).
c. Maximum temperature: +167°F (+75°C).

2-18. Installation of 24-Pin Option 024

2-19. To extend the testing capability of the 5045A to IC's with up to 24 pins, install Option 024 as follows:

a. Disconnect power and remove top cover of 5045A.

CAUTION

Pin driver boards are wrapped in anti-static protective bags. These boards are very susceptible to static discharge damage. Remove each board from its bag separately and handle only by the large black heat sink or by the board extractors.

b. Insert the four-pin driver board (Part No. 05045-60013) into slots A17, A18, A19, and A20.

c. Perform the Operational Verification Test in Section IV to ensure proper operation.

2-20. Installation and Rack Mount Option 908

2-21. Install the Optional rack mount flange kit, Part No. 5061-0078 per instructions on the label provided with the kit.

2-22. AUTOMATIC HANDLER SIGNALS

2-23. When an automatic handler is to be installed, the interface signals are connected via the 5045A rear panel connector J5. All signals are negative-true logic. Table 2-1 lists the signals at each active pin of connector J5. The name of the signal indicates the condition that occurs at that pin (relative to front panel indicators). Figure 2-2 shows the timing of the signals in reference to the $\overline{\text{End of Test}}$ signal. The signals occur only when the named signal condition exists. The duration of all signals is as shown, within ±5 milliseconds.

2-24. INSTALLATION AND OPERATION OF MONOSTABLE MULTIVIBRATOR ADAPTER A36

2-25. Insert adapter (A36) in the 24-pin test socket on the 5045A standard test head assembly. Follow card loading procedure (see paragraph 3-7) and set the switches on A36 to the ON position as noted in the IC header printout. All other switches must be set in the OFF position. The following printouts are typical for use of the multivibrator adapter.

```
74123 DIAGNOSTIC          74123 P/F USE WITH
USE BOARD 5045-50041      HANDLER OR FLATPACKS
 SWITCH ON: ABGHINP       ---SEE DATA SHEET---
```

Table 2-1. Automatic Handler Signals

J5 Pin	Signal
	NOTE Signals are TTL levels (true = +0.4V @ 6 mA, False + 2.4V).
1	$\overline{\text{Fail Cont}}$
2	$\overline{\text{End of Test}}$
5, 12	+5V @ 100 mA
6, 13	System Common
9	$\overline{\text{Pass}}$
10	*$\overline{\text{Start Test}}$
11	$\overline{\text{Fail Function}}$

*The $\overline{\text{Start Test}}$ signal is sent from the handler. It must have a 5 ms minimum duration and then go False at the time the $\overline{\text{End of Test}}$ signal goes true (true = 0.4V @ 6 mA, False = 2.4V).

Note: the Handler Signal Timing may be verified by executing a procedure outlined in the Performance Test, see Section IV.

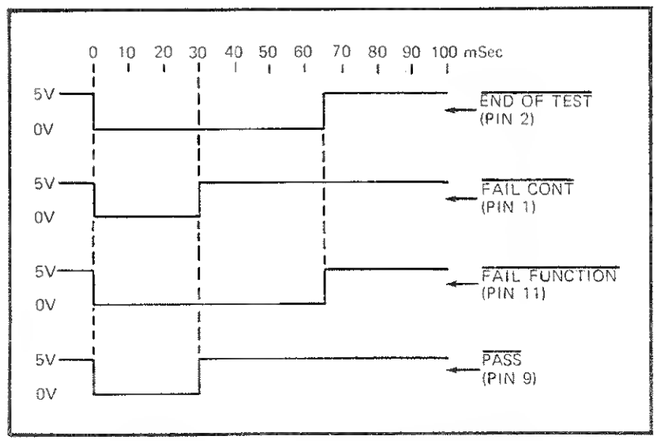


Figure 2-2. Automatic Handler Signal Timing

SECTION III
OPERATION

3-1. INTRODUCTION

3-2. This section contains operating information for the 5045A. This includes a description of the controls and indicators, proper setup for use with an automatic handler, printout data, a self-check procedure, and operator's maintenance. Also see 5045A Users Manual for detailed operating instructions.

3-3. PROGRAM CARDS

3-4. The program cards store all information unique to the testing of a particular IC. The underside of the card contains a coating of magnetic material responsible for storing this information. When using the cards, try not to touch its magnetic coating since the oil film left from your fingers can cause the card to slip as its being pulled through the card reader. Figure 3-1 shows the proper method of holding the card.

NOTE

To prevent accidental "erasure" of the card, keep the card away from electrical motors and other such devices. Do not lay the card on top of the tester.

CAUTION

LAYING THE CARD ON ABRASIVE SURFACES CAN CAUSE PERMANENT DAMAGE TO THE CARD'S MAGNETIC COATING. RETURN THE CARD TO ITS FOLDER AFTER USE.

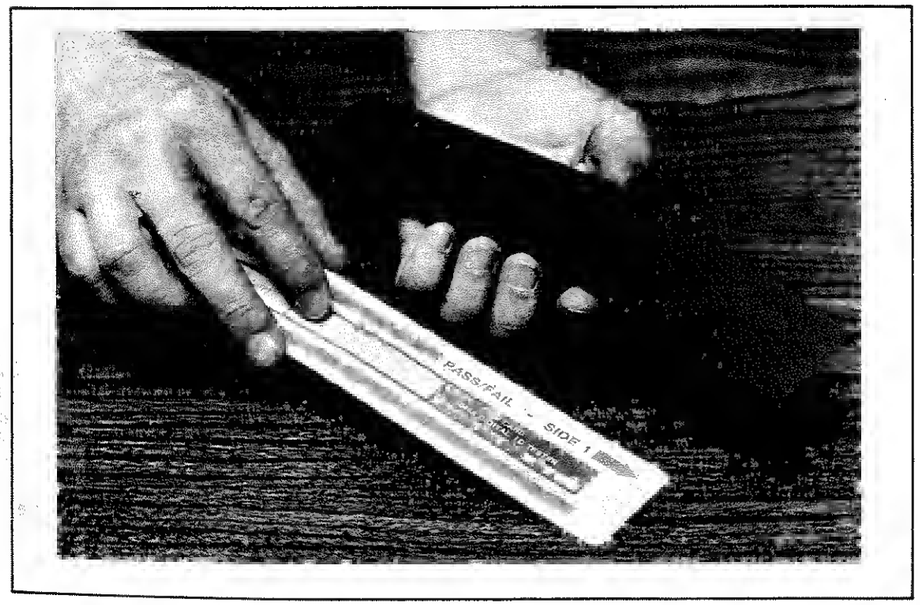


Figure 3-1. Handling the Program Cards

3-5. Two Tests Available

3-6. There are two program cards for each IC. One card contains a PASS/FAIL test while the other card performs a DIAGNOSTIC test. Using the PASS/FAIL test results in faster test times because of the consolidation of tests and the reduced amount of failure data available for printing. Figure 3-2 describes the pertinent information on the cards.

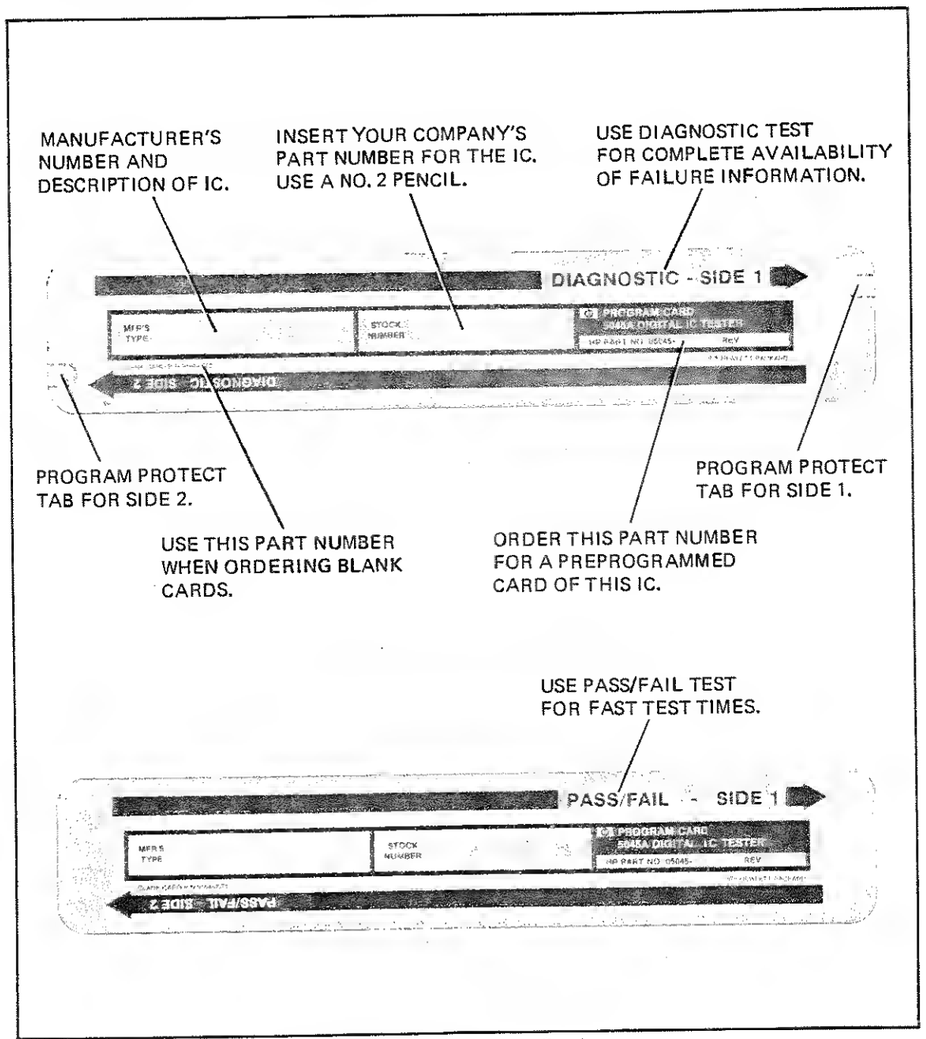


Figure 3-2. Program Cards

3-7. Loading the Card

3-8. Apply power, select one of the test cards, push the LOAD button, and insert side 1 of the card face up into the lower front panel slot. The instrument will automatically route the card into the machine and out the other slot. If the LOAD light stays on, it is an indication that more information is needed. Load side 2 of the magnetic card in the same manner.

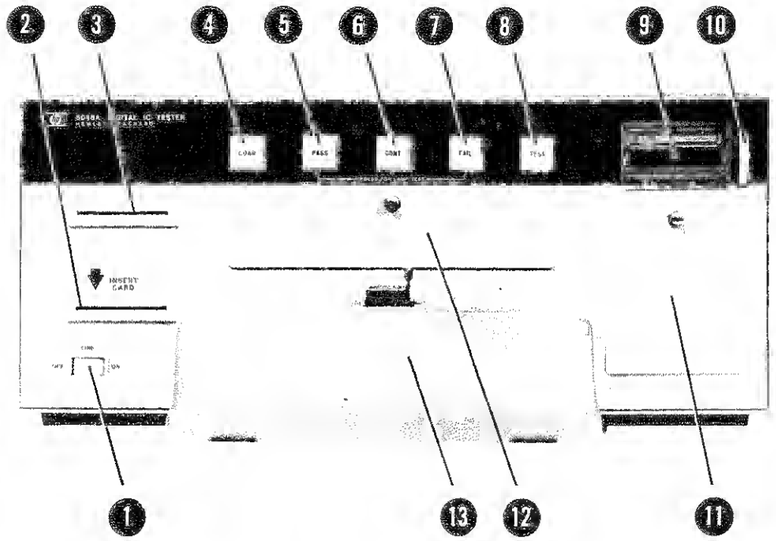
3-9. Verification of Load Operation

3-10. Once the card is loaded, note the printer paper. If the tester accepted the card's information, it will print the manufacture's IC number and the type of test to be performed. If the tester determines that the check sum does not agree with the sum recorded on the card, it will print the word "RELOAD". In this case, push the LOAD button and reload the card.

```
RELOAD

7476 PASS/FAIL

7476 DIAGNOSTIC
```

3-11. Program Protect Tabs

3-12. Each card contains two *program protect* tabs, located near the arrowheads. Removing either of these tabs prevents the operator from accidentally writing over the existing program. Once the tabs are removed, however, the card cannot be reprogrammed. If the tabs have not been removed, the card can be reprogrammed, but it is highly recommended that the card first be bulk erased.



a. LINE switch (1). ON position supplies line power to the tester.

b. Input slot (2) of the card reader. Accepts the magnetic program card when LOAD button (6) is pushed. Enter card with white side up. Check that the arrow on card matches up.

c. Output slot (3) of the card reader. Magnetic program card exits here as program information is being accessed.

d. LOAD button (4). Allows card reader to accept program card.

e. PASS light (5) lights to indicate the IC passed the tests given it and is considered good.

f. CONT light (6) lights to indicate the IC has failed the continuity test.

g. FAIL light (7) flashes red when the IC fails any of its tests.

h. TEST button (8). Push to initiate one test sequence on an IC. Used in the manual mode. Lamp lights to indicate that test is in progress. Can be used to terminate a test sequence by pressing while a test is in progress.

i. Paper Deflector/Cutoff Bar (9) guides paper out of thermal printer. Knife edge on plastic bar allows paper to tear off cleanly.

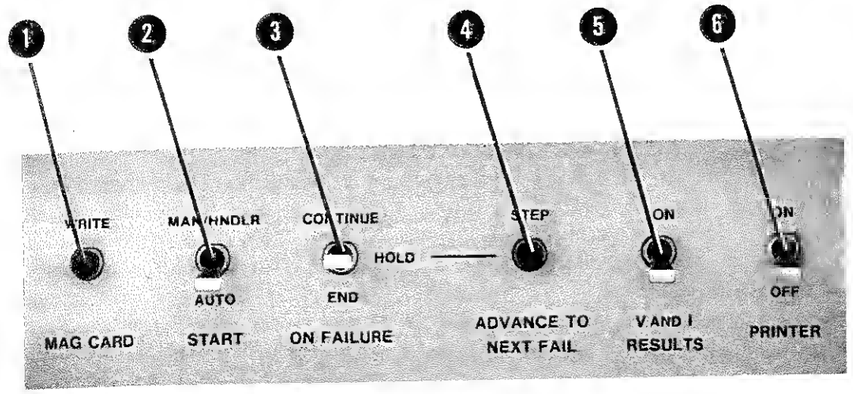
j. Paper Advance knob (10). Manually rotating the knob downward advances the paper past the print head. Do not advance paper by pulling on tape or the paper will bind.

k. Paper Tray door (11). To gain access to paper roll, rotate knob counterclockwise and pull.

l. Control Panel door (12). To gain access to controls, rotate knob counterclockwise and pull. See Figure 3-4 for description of controls.

m. Test Head (13). Holds special sockets for testing IC's. Removed when using an automatic handler.

Figure 3-3. Front Panel Controls and Indicators



a. MAG CARD WRITE button ❶. When pushed, enables tester to duplicate program data onto a blank card. A preprogrammed card must be entered prior to pushing the button.

b. START switch ❷ selects AUTO (automatic) or MAN/HNDLR (Manual/handler) position.

   1. In AUTO position, tester runs multiple test sequences on a single IC. Automatically initiates new test when present test is completed. Also can be used in manual test operation (see users manual).
   2. Use MAN/HNDLR position when using an automatic IC handler or when manually testing using the TEST button.

c. ON FAILURE switch ❸ affects the advance of the tests once a failure is detected.

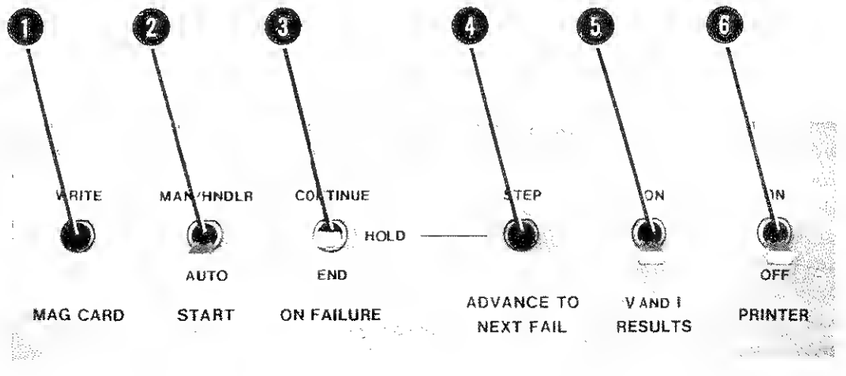
   1. END ON FAILURE position terminates test sequence when a failure is detected.
   2. HOLD ON FAILURE position stops test sequence where the failure occurs. See description for ADVANCE TO NEXT FAIL button.
   3. CONTINUE ON FAILURE position allows completion of test sequences, regardless of failures. With printer on, provides a summary of failures.

d. ADVANCE TO NEXT FAIL button ❹ is functional only when ON FAILURE switch ❸ is in the HOLD position. Pushing button advances test sequence to next failure where test sequence stops again.

e. V AND I RESULTS switch ❺ affects content of printout when printer is turned on and an IC fails under test. Off (down) position allows printout of basic failure data. The ON position allows printout of all pins, including their voltage and current data. (V AND I printout is not available with ON FAILURE switch set to CONTINUE.)

f. PRINTER switch ❻. Printer becomes fully operational with switch set to ON position. Even with switch set to off position, printer will record the card-loading information.

Figure 3–4. Recessed Panel Controls



To reduce test times and prevent handling errors, the front panel controls should be set as follows:

a. Set the START switch ❷ to the MAN/HNDLR position.

b. Set the ON FAILURE switch ❸ to the END position.

c. Set the V AND I RESULTS switch ❺ to the off (down) position.

d. Set the PRINTER switch ❻ to the OFF position.

NOTE

It is important to use the PASS/FAIL program card to reduce the test time.

Figure 3-5. Control Settings for Handler Use

3-13. SELF CHECK PROCEDURE

3-14. Each day, before testing begins, a self-check procedure may be run on the tester to ensure the machine is operating properly. This procedure puts the tester through a rigorous test to ensure proper operation. The test can be found in Section IV under Operational Verification.

3-15. LOADING THE IC

3-16. Select the test socket that is compatible with the IC to be tested. Ensure that pin 1 of the IC matches pin 1 of the test socket (marked on the housing). Raise the test socket's locking lever, place the IC into the socket, and secure the IC into place by lowering the lever to its horizontal position.

3-17. MULTIPLE TESTING OF A SINGLE IC

3-18. Multiple testing is the ability to perform repeated test sequences on a single IC and record any failures. The IC might fail only one test in a thousand, but the failure will not go undetected. The internal counter that records the number of passes and failures is reset when a program card is first loaded. This should be done if a record is to be kept.

3-19. Multiple testing is also a useful mode to use when manually testing a group of IC's (i.e., without a handler). This mode eliminates the operation of pressing the TEST button for each new IC. Good IC's are indicated by the PASS light coming on shortly after the socket lever is lowered. (Between tests the FAIL light will be on, since the tester is testing an empty socket.)

3-20. Multiple Test Setup

3-21. Multiple testing is available by placing the START switch in the AUTO position. Also, for fast operation, set the ON FAILURE switch to END, the V AND I RESULTS switch to off (down) and the PRINTER switch to OFF. The TEST light will stay lit while the other lights reflect the test results. This method of testing is totally automatic and should *not* be used when operating from a handler. The tester may be attempting to perform a check while the handler is shifting in a new IC.

3-22. RETRIEVING PASS/FAIL INFORMATION

3-23. The tester records the number of failures even though no printing occurred. To retrieve this information, it is necessary to induce a failure (or wait until the next failure). The following procedure will cause the tester to print the number of failures and passes.

a. Set the START switch to MAN/HNDLR.
b. ON FAILURE switch to END.
c. Set the PRINTER switch to ON.
d. Remove the IC from its test socket.
e. Push the TEST button, once.

3-24. The tester will now print the failure data. Of importance here is the number of recorded failures minus one: the one that was induced. In the example below, the IC passed 45 test sequences and failed once of its own accord. If the printer had recorded only one failure (the induced one), the IC tested good.

```
TEST:   FAN OUT
FAIL     2PASS     45
CORRECT 1001001
PIN
STATE 1>1100010
FAIL PIN:  3
```

3-25. DUPLICATING MAGNETIC CARDS

3-26. The Digital IC Tester has the ability of duplicating magnetic cards. The tester does this by "learning" the information from a card containing program data (a source card) and transferring that data to a blank card.

NOTE

Cards missing their *program protect* tabs cannot be reprogrammed.

3-27. Duplicating Procedure

3-28. Use the following procedure when duplicating program cards.

a. Set the START switch to the MAN/HNDLR position.

b. Push the LOAD button and insert side 1 of the *source* card (the card already programmed) into the tester. If the LOAD light does not go off, insert side 2 of the source card. The printer will now printout the IC number and the type of test. This verifies that proper loading has occurred. The program stored in the tester can now be transferred to the blank card.

c. Push the WRITE button — the LOAD light should come on.

d. Load side 1 of the blank card into the tester. Load side 2 if the LOAD light does not turn off. Any number of cards can be made in this manner without reloading the source card.

e. To verify for proper duplicating, see paragraph 3-31 below.

3-29. MAKING A ROM PROGRAM CARD

3-30. A feature of the tester is the ability to produce a program card for any ROM, regardless of the ROM's program. To do this, first load the PROGRAM/STIMULUS card for the type of ROM (or PROM) that you're going to test. Then insert and test a known good ROM that contains your own output pattern. The tester "learns" the ROM's program and stores that information in its memory. Next, push the WRITE button and load a *blank* card. The tester will write the ROM's stimulus sequence from the first card and the output pattern from the reference ROM onto the blank card. This newly programmed blank card now becomes the test card to which all subsequent ROM's with that pattern can be tested.

3-31. Verification

3-32. Once the newly programmed card contains the duplicated program information, a verification of the program should be made. Push the LOAD button and insert side 1 of the new card and then side 2, if necessary. The printer should list the test for the type of card entered.

```
RELOAD

7476 PASS/FAIL

7476 DIAGNOSTIC
```

3-33. The printer will print the word "RELOAD" if the card didn't accept all of the program information available to it. In such case, first try reloading the card, if this doesn't work reload the source card and the blank card, as described earlier.

3-34. CARD READER CLEANING CARD

3-35. The tester is supplied with a special card that cleans the head of the magnetic card reader. This card is abrasive to the head assembly, therefore use it only when necessary. For example, if the tester printed "RELOAD" after four different program cards were loaded, it would be an indication that the card reader may need cleaning. Load the card in the same manner as a regular program card. Additional instructions are given on the card.

3-36. Power must be turned off to terminate the cleaning operation.

CAUTION

EXCESSIVE USE OF THIS CARD WILL DAMAGE THE READ/ WRITE HEAD.

SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION

4-2. The procedure described in this section tests the instruments electrical performance using the specifications listed in Table 1-2 as the performance standards.

4-3. EQUIPMENT REQUIRED

4-4. Equipment required for the performance tests is listed in the Recommended Test Equipment table in Section I (Table 1-3).

4-5. OPERATIONAL VERIFICATION AND PERFORMANCE TESTS

4-6. Two sets of tests are provided in the following paragraph. The Operational Verification test will indicate whether the instrument tested operates correctly in all modes. The Performance Test is more extensive and may be performed after the Operational Verification Test to measure the condition of the instrument tested with respect to the new instrument specifications. Both tests require the use of pre-programmed magnetic cards which are included as part of the Diagnostic Card Kit.

4-7. IN-CABINET PERFORMANCE TEST CARD

4-8. The Operational Verification Test Card, page 4-6a, is provided to allow results of the tests to be recorded. A series of these cards with data taken at periodic intervals can be used to show trends in performance.

Table 4-1. Operational Verification Test

I. SELF CHECK 1, 2, and 3
II. R-PACK TESTS (Precision Resistor Pack Tests)
a. V/I R-PACK
b. R-PACK C-Current Modes Check
c. R-PACK Failure Detect Check

4-9. Operational Verification Test

4-10. The Operational Verification Test for the 5045A IC Tester consists of several self check routines that quickly verify correct operation of the major testing modes of the instrument. This test may be run each day to verify correct operation. For a rigorous verification of all 5045A specifications, refer to the Performance Test Paragraph 4-35.

4-11. The Operational Verification Test is divided into two parts: Part I uses a dummy IC along with special program cards to check several programmed modes of voltages and currents. In these tests, pin drivers are used in pairs. One driver is used as a source and the other becomes a measuring device. In Part II, a special precision resistor pack is used to obtain information about individual pins and their parameters.

4-12. Part I: Self Checks 1, 2 and 3

a. Set the front panel switches as follows:

START — MAN/HNDLER
ON FAILURE — CONTINUE
V and I RESULTS — OFF (down)
PRINTER — ON

b. Install the Dummy IC in the test socket. For Option 024 (24-pin instruments), use the IC (HP P/N 0S04S-80020). The 16-pin IC should be used for standard 16-pin instruments (HP P/N 0S04S-60019). The 20-pin socket adapter (HP P/N 0S045-60032) must be used with 16-pin ICs.

4-13. Self Check 1

a. Load the correct "Self Check 1" program card for 16-pin or 24-pin instrument. The following printout will be produced:

```
SELF CHECK 1
  CPU RDR PRNTR OK
```

The printout indicates that the S045A's card reader, central processing unit, and printer are operating properly.

c. Press TEST. Verify that the PASS light illuminates. There should be no printer output.

4-14. Self Check 2

a. Load the correct "Self Check 2" card for 16-pin or 24-pin instrument. This self check program is a test of relative accuracy for several modes of voltage and current setup conditions.

b. Press TEST. Verify that the PASS light illuminates. There should be no printer output.

4-15. Self Check 3

Note: Self check 3 will not operate with instrument serial numbers 1620A001S5 and below.

a. Load the correct "Self Check 3" card for 16-pin or 24-pin instruments. This self check program further exercises the pin driver voltage and current generators.

b. Press TEST. Verify that the PASS light illuminates. There should be no printer output.

4-16. Part II: R-Pack Operational Verification Tests

a. The precision resistor pack (R-Pack HP P/N 0504S-60042) is used with special program cards to gain additional information about individual voltage and current parameters for each pin of the IC tester. The R-Pack loads each pin of the IC tester with a precision 1KΩ resistor. The 24 resistors tie to a common ground point. When testing is performed, the R-Pack is inserted in the test socket and its ground lead is connected to A30TP2S (marked ⏚). The R-Pack tests uses the voltage and current generator along with the V and I Results function to produce a printed output for each pin.

4-17. The R-Pack Operational Verification consists of the following tests:

a. V/I Performance

Analog Accuracy
V/I Results Function

b. Pin Driver C-Current Modes Check

c. Failure Detect Check

4-18. V/I Performance Check

4-19. This test verifies that the pin driver voltage and current generators along with the V and I Results function are working properly.

4-20. Remove the Test Head cover.

a. Set 5045A Front Panel switches to:
START — MAN/HNDLR
ON FAILURE — HOLD
V and I RESULTS — ON (UP)
PRINTER — ON

Note: all of the tests for each program card may be executed automatically by setting ON FAILURE to CONTINUE.

b. Turn on 5045A and load "V/I R-PACK — 24-pin" or "V/I R-PACK — 16-pin" for 24-pin or 16-pin instrument, respectively.

c. Install R-PACK in Test Head socket.

d. Connect R-PACK ground lead to A30TP25 (marked ⏚).

4-21. The V/I R-Pack check consists of four operational modes with a corresponding printout for each.

4-22. +7V, +7 mA Mode

a. Press TEST.

b. A printout similar to Figure 4-1 will be produced.

c. *All* pins should be listed as failing.

d. Note that each pin is listed twice. For example, observe the data for pin 24. The "L" in the printout denotes the programmed value of the voltage or current. The lower line denotes that 7 mA was forced (programmed) and the resultant voltage is 7.05V (1KΩ resistors are loading each pin). The upper line for pin 24 denotes that 7V was applied and the resultant current was 7.0 mA.

e. In each printout line, the parameter of importance is the result of the forced current or applied voltage. Voltage printouts will always be on the left and current printouts on the right.

f. For the 7V, 7 mA printout, make sure that voltage and current results for all pins are within the following limits.

7V, 7 mA
7V ±0.40V (6.60/7.40V)
7 mA ±0.40 mA (6.60/7.40 mA)

```
TEST:   7V,7MA
FAIL      3PASS      0
20      7LV        7 MA
20   7.05 V        7LMA
21      7LV     7.04 MA
21   7.02 V        7LMA
22      7LV        7 MA
22   7.04 V        7LMA
23      7LV     7.08 MA
23   6.98 V        7LMA
24      7LV        7 MA
24   7.05 V        7LMA
CORRECT 111111111111
PIN
STATE 1>111111111111
FAIL PIN:   1    2    3
    4    5    6    7    8
    9   10   11   12   13
   14   15   16   17   18
   19   20   21   22   23
   24
```

Figure 4-1. Typical printout for R-Pack Test (partial printout)

4-23. 1V, 1 mA

a. Press ADVANCE TO NEXT FAIL. The "1V, 1 mA" printout will be produced.

b. Examine the voltage and current parameters as done in paragraph 4-22.

c. Verify the following limits for all pins.

1V, 1 mA
1V ±60 mV (0.940/1.060V)
1 mA ±60 μA (0.940/1.060 mA)

4-24. -7V, -7 mA

a. Press ADVANCE TO NEXT FAIL. The "-7V, -7 mA" printout will be produced.

b. Examine the voltage and current parameters as in paragraph 4-22. Verify the following limits for all pins.

-7V, -7 mA
-7V ±40 mV (-7.40/-6.60V)
-7 mA ±40 μA (-7.40/6.60 mA)

4-25. -1V, -1 mA

a. Press ADVANCE TO NEXT FAIL. The "-1V, -1 mA" printout will be produced.

b. Examine the voltage and current parameters as in paragraph 4-22.

c. Verify the following limits for all pins.

-1V, -1 mA
-1V ±6 mV (-1.060/-.940V)
-1 mA ±60 μA (-1.060/-.940 mA)

4-26. Pin Driver C-Current Modes Check

4-27. This test sets up the pin driver in typical continuous current modes. The continuous current function allows for current generators to be turned on independently of the logic state of the pin under test. In each of the tests, both the Logic 1 and Logic 0 current generators are turned on simultaneously. The resultant output current is the difference between the programmed Logic 1 and Logic 0 currents.

a. Load "R-Pack C-Current Modes — 24-Pin" or "R-Pack C-Current Modes — 16-Pin" for 24-pin or 16-pin instrument, respectively.

4-28. 7V, 7 mA +12, C-5

NOTE

+12, C-5 denotes that the Logic 1 and Logic 0 currents are +12 mA and -5 mA, respectively. C-5 means that the Logic "0" source is turned on continuously for -5 mA.

a. Press TEST. The "7V, 7 mA +12, C-5" printout will be produced.

b. Examine the voltage and current parameters as in paragraph 4-22. Verify the following limits for all pins.

7V ±1.1V (5.9/8.1V)
7 mA ±1.1 mA (5.9/8.1 mA)

4-29. 1V, 1 mA +2, C -1

Logic 1 Current Source: +2 mA
Logic 0 Current Source: -1 mA continuous

a. Press ADVANCE TO NEXT FAIL. The "1V, 1 mA +2, C-1" printout will be produced.

b. Examine the voltage and current parameters as in paragraph 4-22.

c. Verify the following limits for all pins.

1V ±0.18V (0.82/1.18)
1 mA ±0.18 mA (0.82/1.18 mA)

4-30. -7V, -7 mA -12, C+5

Logic 1 Current Source: +5 mA Continuous
Logic 0 Current Source: -12 mA

a. Press ADVANCE TO NEXT FAIL. The "-7V, -7 mA -12, C+5" printout will be produced.

b. Examine the voltage and current parameters as in paragraph 4-22.

c. Verify the following limits for all pins.

-7V ±1.1V (-8.1/5.9V)
-7 mA ±1.1 mA (-8.1/-5.9) mA)

4-31. -1V, 1 mA -2, C+1

Logic 1 Current Source: +1 mA Continuous
Logic 0 Current Source: -2 mA

a. Press ADVANCE TO NEXT FAIL. The "-1V, -1 mA -2, C+1" printout will be produced.

b. Examine the voltage and current parameters as in paragraph 4-22.

c. Verify the following limits for all pins.

-1V ±.18 (-1.18/-0.82V)
-1 mA ±.18 (-1.18/-0.82 mA)

4-32. Failure Detection Circuitry Check

4-33. The failure detection circuitry check verifies that the tester can indicate failing conditions for IC's under test. Failing voltage and current conditions are set up with the R-Pack. Source and load parameters are tested for each pin. The four tests are as follows:

Test 1 Even Pins "Source" Logic 1
Odd Pins "Load" Logic 0

Test 2 Even Pins "Load" Logic 0
Odd Pins "Source" Logic 1

Test 3 Even Pins "Load" Logic 1
Odd Pins "Source" Logic 0

Test 4 Even Pins "Source" Logic 0
Odd Pins "Load" Logic 1

a. Set S04SA front panel switches as in paragraph 4-20 except:

ON FAILURE — CONTINUE
V and I RESULTS — OFF (Down)

b. Remove R-Pack from the test socket.

c. Load "R-Pack Fail Detect Check — 24-Pin" or "R-Pack Fail Detect Check — 16-Pin" for 24-pin or 16-pin instrument.

d. Press TEST. PASS light should illuminate and no printout will be produced.

e. Install R-Pack in test socket and connect ground lead to A30TP25 (marked ⏚).

f. Press TEST. Printout should begin. For all four tests, verify that every pin is listed in the FAIL PIN information. For 16-pin instruments, pins 1-16 should fail. For 24-pin instruments, pins 1-24 should fail. If any pin is not listed in any or all of the tests, then there may be a problem with the failure detect circuitry for that pin. If this occurs, reinsert the R-Pack and run the test again. If problem still occurs refer to Troubleshooting, Section VIII.

4-34. Successful completion of R-Pack Tests 1, 2, and 3 along with positive self check results indicates that with high probability the S045A Digital IC Tester is functioning properly. For a complete verification of all S04SA published specifications, the Performance Test must be executed.

Operational Verification Test Card

HEWLETT-PACKARD MODEL 5045A
IC TESTER

Test Performed _____
Date _____

SERIAL NO. _____

DESCRIPTION	CHECK
1. Self Check 1	_____
2. Self Check 2	_____
3. Self Check 3	_____
4. V/I R-Pack	_____
5. R-Pack C-Current Modes	_____
6. R-Pack Fail Detect Check	_____

NOTE: Tests 4, 5, 6 printout tapes should be fastened to this Test Card.

4-35. PERFORMANCE TEST

4-36. The 5045A Performance Test, outlined in Table 4-2 is used to verify that all operational modes of the IC tester are functioning correctly. In addition, all voltage and current specifications are verified. This Performance Test may be used for incoming inspection, periodic certification, troubleshooting and post-repair verification.

Table 4-2. Performance Test Outline

I.	DAC Adjustment Check DAC Reference Level V Zero, V Gain I Zero, I Gain
II.	Analog Voltage Check Part I Hi, Lo Range Part II Logic Levels
III.	Analog Current Check Low Range 200 mA Range Continuous Current Modes
IV.	Cross Talk Part I, II
V.	Failure Detection Circuitry Check
VI	V and I Results Check Voltage Current V/I Offset
VII.	Fast Edge Check Pos Rise Time Neg Rise Time
VIII.	Relays Check
IX.	Op Code Check
X	Printer Check
XI	Automatic IC Handler Signals Check (Optional)

4-37. DAC ADJUSTMENT CHECK

4-38. The "DAC Adj Check" test verifies proper alignment of the A11 Reference Level Generator (DAC). This procedure may be deleted if an alignment has just been performed.

a. Remove test head cover. Tilt up the front portion of the cover (the cover hinges at the rear).

b. Attach DVM ground lead to A30 TP25 (marked ⏚). Remove R-Pack if installed.

c. Set front panel switches as follows:

START — MAN/HNDLR
ON FAILURE — HOLD
V and I RESULTS — DOWN
PRINTER — ON

d. Load "DAC Adjust CHECK"

4-39. Test 1: DAC REF 7.5V

4-40. This test verifies that the DAC reference level is correct.

a. Press TEST. The "DAC REF 7.5V" printout will be produced.

b. Measure voltage on TP8.

c. Verify the following limits of 7.5V ~~±5~~ ±15 mV.

4-41. Test 2: -V Zero 2 0V

4-42. This test verifies correct zero offset for the -V Level Generator.

a. Press ADVANCE TO NEXT FAIL. The "-V Zero 2 0V" printout will be produced.

b. Measure voltage on TP8.

c. Verify the following limits of 0.00V ±10 mV.

4-43. Test 3: +V Zero 2 0V

4-44. This test verifies correct zero offset for the +V Level Generator.

a. Press ADVANCE TO NEXT FAIL. The +V Zero 2 0V printout will be produced.

b. Measure voltage on TP8.

c. Verify the following limits of 0.00V ±10 mV.

4-45. Test 4: "+6.5V Logic 1"

4-46. This test verifies the +6.5V Gain adjustment of the +V Level Generator.

a. Press ADVANCE TO NEXT FAIL. The "+6.5V Logic 1" printout will be produced.

b. Measure voltage on TP8.

c. Verify the following limits of +6.5V ±10 mV.

4-47. Test 5: "+6.5V Logic 0"

4-48. This test verifies the +6.5V Gain adjustment of the -V Level Generator.

a. Press ADVANCE TO NEXT FAIL. The "+6.5V Logic 0" printout will be produced

b. Measure voltage on TP8.

c. Verify the following limits of +6.5V ±10 mV.

4-49. Test 6: -6.5V Logic 1

4-50. This test verifies the -6.5V Gain adjustment of the +V Level Generator.

a. Press ADVANCE TO NEXT FAIL. The "-6.5V Logic 1" printout will be produced.

b. Measure voltage on TP8.

c. Verify the following limits of -6.5V ±10 mV.

4-51. Test 7: -6.5V Logic 0

4-52. This test verifies the -6.5V Gain adjustment of the -V Level Generator.

a. Press ADVANCE TO NEXT FAIL. The "-6.5V Logic 0" printout will be produced.

b. Measure voltage on TP8.

c. Verify the following limits of -6.5V ±10 mV.

4-53. Test 8: Current Gen, +10 mA

4-54. This test verifies proper gain for the +I Level Generator. Switch meter to current mode.

a. Press ADVANCE TO NEXT FAIL. The "Current Gen. +10 mA" printout will be produced.

b. Measure current at TP8.

c. Verify the following limits of 10 mA ±.6 mA.

4-55. Test 9: Current Gen, -10 mA

4-56. This test verifies proper gain for the -I Level Generator.

a. Press ADVANCE TO NEXT FAIL. The "Current Gen. -10 mA" printout will be produced.

b. Measure current at TP8.

c. Verify the following limits of -10 mA ±.6 mA.

4-57. Test 10: +I Zero, +10 μA

4-58. This test verifies proper zero offset for the +I Level Generator.

a. Press ADVANCE TO NEXT FAIL. The "I Zero +10 μA" printout will be produced.

b. Measure current at TP8.

c. Verify the following limits of +10 μA ±5 μA.

4-59. Test 11: -I Zero, -10 μA

4-60. This test verifies proper zero offset for the -I Level Generator.

a. Press ADVANCE TO NEXT FAIL. The "I Zero -10 μA" printout will be produced.

b. Measure current at TP8.

c. Verify the following limits of -10 μA ±5 μA.

4-61. If all limits have been satisfied for all 11 tests then the A11 Reference Level Generator (DAC) is properly aligned. Perform the complete A11 adjustment procedure as described in Section V, if any of the tests failed.

4-62. Analog Voltage Check

4-63. The Analog Voltage Check is a verification of the accuracy of programmed voltage levels. The test is divided into two parts.

a. Part I

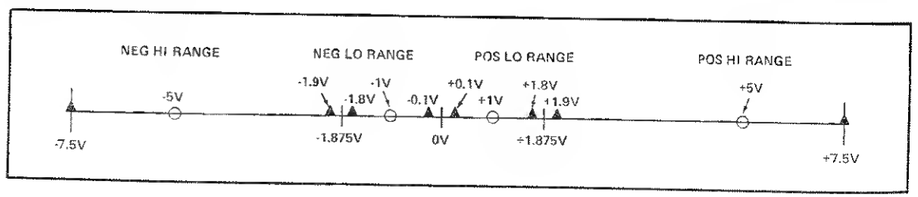
+7.5V, Pos High Range High End Logic 1
+1.9V Pos High Range Low End Logic 1
+1.8V Pos Low Range High End Logic 1
+0.1V Pos Low Range Low End Logic 1

-7.5V Neg High Range High End Logic 0
-1.9V Neg High Range Low End Logic 0
-1.8V Neg Low Range High End Logic 0
-0.1V Neg Low Range Low End Logic 0

b. Part II

+5V Logic 1
+5V Logic 0
-5V Logic 1
-5V Logic 0
+1V Logic 1
+1V Logic 0
-1V Logic 1
-1V Logic 0

4-64. The following graph shows the breakdown of the IC Tester's High and Low Voltage Ranges. The ▲ marks denote the voltages checked in Part I. "○" marks denote voltages checked in Part II.



4-65. Part 1

a. Set front panel switches as in paragraph 4-38.
b. Load "Analog Voltage Check Part 1".
c. Press TEST.

4-66. Test 1: +7.5V Pos High Range, High End

a. Measure voltage on Test Points 1-24.
b. Verify the following limits of +7.5V ±25 mV for all pins.

4-67. Test 2: +1.9V Pos High Range, Low End

a. Press ADVANCE TO NEXT FAIL.
b. Measure voltage on Test Points 1-24.
c. Verify the following limits of +1.9V ±25 mV for all pins.

4-68. Test 3: +1.8V Pos Low Range High End

a. Press ADVANCE TO NEXT FAIL.
b. Measure voltage on Test Points 1-24.
c. Verify the following limits of +1.8V ±15 mV for all pins.

4-69. Test 4: +0.1V Pos Low Range, Low End

a. Press ADVANCE TO NEXT FAIL.
b. Measure voltage on Test Points 1-24.
c. Verify the following limits of +0.1V ±15 mV for all pins.

4-70. Test 5: -7.5V Neg High Range, High End

a. Press ADVANCE TO NEXT FAIL.
b. Measure voltage on Test Points 1-24.
c. Verify the following limits of -7.5V ±25 mV for all pins.

4-71. Test 6: -1.9V Neg High Range, Low End

a. Press ADVANCE TO NEXT FAIL.
b. Measure voltage on Test Points 1-24.
c. Verify the following limits of -1.9V ±25 mV for all pins.

4-72. Test 7: -1.8V Neg Low Range, High End

a. Press ADVANCE TO NEXT FAIL.
b. Measure voltage on Test Points 1-24.
c. Verify the following limits of -1.8V ±15 mV for all pins.

4-73. Test 8: -0.1V Neg Low Range, Low End

a. Press ADVANCE TO NEXT FAIL.
b. Measure voltage on Test Points 1-24.
c. Verify the following limits of -0.1V ±15 mV for all pins.

4-74. Part II

4-75. Voltage Limit Verification for Pos and Neg Logic Modes.

a. Load "Analog Voltage Check Part II".

4-76. Test 1: +5V Logic 1

a. Press TEST.
b. Measure voltage on Test Points 1-24.
c. Verify the following limits of +5V ±25 mV for all pins.

4-77. Test 2: +5V Logic 0

a. Press ADVANCE TO NEXT FAIL.
b. Measure voltage on Test Points 1-24.
c. Verify the following limits of +5V ±25 mV for all pins.

4-78. Test 3: -5V Logic 1

a. Press ADVANCE TO NEXT FAIL.
b. Measure voltage of Test Points 1-24.
c. Verify the following limits of -5V ±25 mV for all pins.

4-79. Test 4: -5V Logic 0

a. Press ADVANCE TO NEXT FAIL.
b. Measure voltage on Test Points 1-24.
c. Verify the following limits of -5V ±25 mV for all pins.

4-80. Test 5: +1V Logic 1

a. Press ADVANCE TO NEXT FAIL.
b. Measure voltage on Test Points 1-24.
c. Verify the following limits of +1V ±15 mV for all pins.

4-81. Test 6: +1V Logic 0

a. Press ADVANCE TO NEXT FAIL.
b. Measure voltage on Test Points 1-24.
c. Verify the following limits of +1V ±15 mV for all pins.

4-82. Test 7: -1V Logic 1

a. Press ADVANCE TO NEXT FAIL.

b. Measure voltage on Test Points 1-24.

c. Verify the following limits of -1V ±15 mV for all pins.

4-83. Test 8: -1V Logic 0

a. Press ADVANCE TO NEXT FAIL.

b. Measure voltage on Test Points 1-24.

c. Verify the following limits of -1V ±15 mV for all pins.

4-84. Analog Current Check

4-85. The Analog Current Check is a verification of the accuracy of programmed current levels. The test is divided into three parts.

4-86. Part I — Low Current Range

±20 mA
±2.6 mA
±2.4 mA
±10 μA

4-87. Part II — High Current Range

±200 mA

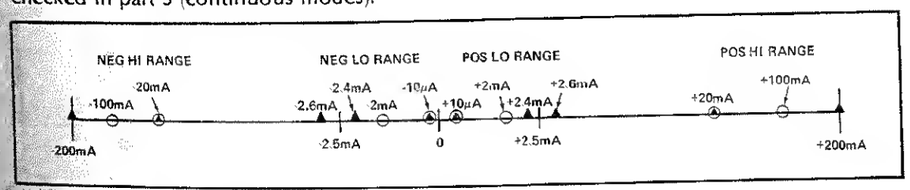
4-88. Part III

a. Continuous Current Modes

±100 mA
±20 mA
±2 mA
±10 μA

b. Voltage Verification for Current Modes

4-89. The following graph shows the breakdown of the IC Testers High and Low current ranges. The "▲" marks denote the currents checked in parts 1 and 2. The "○" marks are for currents checked in part 3 (continuous modes).



4-90. Part I — Analog Current Check Low Range

a. Set up DVM to measure DC current.

b. Connect ground level to TP25 (marked ⏚).

c. Load "Analog Current Check Low Range".

4-91. Test 1: +20 mA

a. Press TEST.
b. Measure current on Test Points 1-24.
c. Verify the following limits of 20 mA ±1.2 mA for all pins.

4-92. Test 2: +2.6 mA

a. Press ADVANCE TO NEXT FAIL.
b. Measure current on Test Points 1-24.
c. Verify the following limits of 2.6 mA ±0.4 mA for all pins.

4-93. Test 3: +2.4 mA

a. Press ADVANCE TO NEXT FAIL.
b. Measure current on Test Points 1-24.
c. Verify the following limits of 2.4 mA ±0.14 mA for all pins.

4-94. Test 4: +10 μA

a. Press ADVANCE TO NEXT FAIL.
b. Measure current on Test Points 1-24.
c. Verify the following limits of 10 μA ±10 μA for all pins.

4-95. Test 5: -20 mA

a. Press ADVANCE TO NEXT FAIL.
b. Measure current on Test Points 1-24.
c. Verify the following limits of -20 mA ±1.2 mA for all pins.

4-96. Test 6: -2.6 mA

a. Press ADVANCE TO NEXT FAIL.
b. Measure current on Test Points 1-24.
c. Verify the following limits of -2.6 mA ±0.4 mA for all pins.

4-97. Test 7: -2.4 mA

a. Press ADVANCE TO NEXT FAIL.
b. Measure current on Test Points 1-24.
c. Verify the following limits of -2.4 mA ±0.14 mA for all pins.

4-98. Test 8: -10 μA

a. Press ADVANCE TO NEXT FAIL.
b. Measure current on Test Points 1-24.
c. Verify the following limits of -10 μA ±10 μA for all pins.

4-99. Analog Current Check 200 mA Range

4-100. The 200 mA ranges are checked with a separate test due to the maximum available current restrictions of the IC Tester. For any one pin setup condition, the total current from either positive or negative current generators may not exceed 600 mA. The test is organized so that only one pin is set up at any one time. The setup condition moves sequentially from pin 1 to 24 each time the ADVANCE TO NEXT FAIL button is pushed. Pin 1 is set up by pressing TEST.

a. Load "Analog Current Check 200 mA Range".

b. Press TEST.

c. Measure current at TP1.

d. Verify the following limits of +200 mA ±12 mA on pin 1.

e. Press ADVANCE TO NEXT FAIL to step test to pin 2. For each step, verify the following limits of +200 mA ±12 mA.

f. After TP24 has been checked, the -200 mA test begins with TP1. Again press ADVANCE TO NEXT FAIL to step through all 24-pins. The spec for the -200 mA test is -200 mA ±12 mA.

4-101. Continuous Current Modes

4-102. The continuous current function allows the current generators to be turned on independent of the logic state. In each of the tests, both the Logic 1 and Logic 0 current generators are turned on simultaneously. The resultant output appearing at the test points is the difference between the positive and negative programmed current levels. The tests are divided between three program cards as follows:

a. Card 1 Pins 1-8
b. Card 2 Pins 9-16
c. Card 3 Pins 17-24

4-103. For any particular test checkpoint, the 8 pins will have different current setups. Refer to Table 4-3 for the expected outputs and limits.

NOTE

For 16-pin instruments, use the program for modes 1-8 and 17-24. Ignore references to pins 9-16.

4-104. Continuous Current Modes 1-8

a. Load "Pindriver C-Current Modes 1-8".

4-105. Test 1

a. Press TEST.

b. Measure current on Test Points 1-8.

c. Verify currents according to Table 4-3 Test 1.

4-106. Test 2

a. Press ADVANCE TO NEXT FAIL.

b. Measure current on Test Points 1-8.

c. Verify currents according to Test 2.

4-107. Continue for remaining tests by pressing ADVANCE TO NEXT FAIL. For each test, verify the currents for Test Points 1-8 by referring to Table 4-3 and the appropriate test number.

4-108. Continuous Current Modes 9-16

a. Load "Pindriver C-Current Modes 9-16".

b. Proceed as in paragraph 4-104 above making reference to pins 9-16 in Table 4-3.

4-109. Continuous Current Modes 17-24

a. Load "Pindriver C-Current Modes 17-24".

b. Proceed as in paragraph 4-104 above making reference to pins 17-24 in Table 4-3.

4-110. Voltage Verification for Current Modes

4-111. This test is a verification of programmed voltage modes for continuous current pin driver setups.

4-112. Use the same procedure and equipment as outlined in paragraphs 4-104 through 4-109 except that voltages will be measured instead of currents. The approximate voltage magnitude is 7 volts. Refer to Table 4-4 for correct voltage levels. Note that for each program card, tests 1 through 4 are programmed for +7V ±25 mV. For tests 5 through 8, the level is -7V ±25 mV.

Table 4-3. Pindriver C-Current Modes (Current)

Pin Number			Test Number							
Card 1-8	Card 9-16	Card 17-24	1	2	3	4	5	6	7	8
1,2	9,10	17,18	+100 mA +/-18 mA	+20 mA +/-3.6 mA	+2 mA +/-.52 mA	+10 μA +20, -10 μA	-100 mA +/-18 mA	-20 mA +/-3.6 mA	-2 mA +/-.52 mA	-10 μA -20, +10 μA
3,4	11,12	19,20	+20 mA +/-3.6 mA	+20 mA +/-.52 mA	+10 μA +20, -10 μA	-100 mA +/-18 mA	-20 mA +/-3.6 mA	-2 mA +/-.52 mA	-10 μA -20 +10 μA	+100 mA +/-18 mA
5,6	13,14	21,22	+2 mA +/-.52 mA	+10 μA +20, -10 μA	-100 mA +/-18 mA	-20 mA +/-3.6 mA	-2 mA +/-.52 mA	-10 μA -20, +10 μA	+100 mA +/-18 mA	+20 mA +/-3.6 mA
7,8	15,16	23,24	+10 μA +20, -10 μA	-100 mA +/-18 mA	-20 mA +/-3.6 mA	-2 mA +/-.52 mA	-10 μA -20, +10 μA	+100 mA +/-18 mA	+20 mA +/-3.6 mA	+2 mA +/-.52 mA

Table 4-4. Pindriver C-Current Modes (Voltages)

Pin Number			Test Number							
Card 1-8	Card 9-16	Card 17-24	1	2	3	4	5	6	7	8
1,2	9,10	17,18	+7V	+7V	+7V	+7V	-7V	-7V	-7V	-7V
3,4	11,12	19,20	+7V	+7V	+7V	-7V	-7V	-7V	-7V	+7V
5,6	13,14	21,22	+7V	+7V	-7V	-7V	-7V	-7V	+7V	+7V
7,8	15,16	23,24	+7V	-7V	-7V	-7V	-7V	+7V	+7V	+7V

Note: +/-25 mV limits for all.

4-113. Cross Talk

4-114. The Cross Talk tests verify that the accuracy of programmed voltage and currents is within specification when cross talk conditions are set up on the Reference Level Generators and the individual pindrivers.

4-115. Cross Talk Part I

a. Set front panel switches as in paragraph 4-38c.
b. Connect DVM ground lead to TP25 (marked ⏚).
c. Connect DVM Positive lead to TP7.
d. Load "Cross Talk Part I".

4-116. Test 1: +V -I

a. Press TEST.
b. Verify the following limits of 7.5V ±25 mV on TP7.

4-117. Test 2: +V -I

a. Press ADVANCE TO NEXT FAIL.
b. Verify the following limits of 7.5V ±25 mV on TP7.

4-118. Test 3: +V +I

a. Press ADVANCE TO NEXT FAIL.
b. Verify the following limits of 7.5V ±25 mV on TP7.

4-119. Test 4: +V +I

a. Press ADVANCE TO NEXT FAIL.
b. Verify the following limits of 7.5V ±25 mV on TP7.

4-120. Test 5: -V +I

a. Press ADVANCE TO NEXT FAIL.
b. Verify the following limits of -7.5V ±25 mV on TP7.

4-121. Test 6: -V +I

a. Press ADVANCE TO NEXT FAIL.
b. Verify the following limits of -7.5V ±25 mV on TP7.

4-122. Test 7: -V -I

a. Press ADVANCE TO NEXT FAIL.
b. Verify the following limits of -7.5V ±25 mV on TP7.

4-123. Test 8: -V -I

a. Press ADVANCE TO NEXT FAIL.

b. Verify the following limits of -7.5V ±25 mV on TP7.

4-124. Set up DVM to measure current (approx. 2 mA).

a. Connect ammeter positive lead to TP7.

b. Ground lead remains on TP25 (marked ⏚).

4-125. Test 9: +I +V

a. Press ADVANCE TO NEXT FAIL.

b. Verify the following limits of 2 mA ±0.12 mA at TP7.

4-126. Test 10: +I +V

a. Press ADVANCE TO NEXT FAIL.

b. Verify the following limits of 2 mA ±0.12 mA at TP7.

4-127. Test 11: +I -V

a. Press ADVANCE TO NEXT FAIL.

b. Verify the following limits of 2 mA ±0.12 mA at TP7.

4-128. Test 12: +I -V

a. Press ADVANCE TO NEXT FAIL.

b. Verify the following limits of 2 mA ±0.12 mA at TP7.

4-129. Test 13: -I -V

a. Press ADVANCE TO NEXT FAIL.

b. Verify the following limits of -2 mA ±0.12 mA at TP7.

4-130. Test 14: -I -V

a. Press ADVANCE TO NEXT FAIL.

b. Verify the following limits of -2 mA ±0.12 mA at TP7.

4-131. Test 15: -I +V

a. Press ADVANCE TO NEXT FAIL.

b. Verify the following limits of -2 mA ±0.12 mA at TP7.

4-132. Test 16:-I +V

a. Press ADVANCE TO NEXT FAIL.

b. Verify the following limits of -2 mA ±0.12 mA at TP7.

4-133. Cross Talk Part II

a. Set DVM to measure voltage (approx. 7.5V). Connect DVM ground lead to TP25 (marked (⏚). Load "Cross Talk Part II".

b. Press TEST. Printer output should be similar to that below:

```
TEST:    1-2
FAIL      2PASS      0
CORRECT 111111111111
PIN
STATE 1>111111111111
FAIL PIN:   1   4   7
  10  13  16  19  22
```

c. Measure voltage on indicated Fail Pins. Voltage should be +7.5V ±25 mV.

d. Press ADVANCE TO NEXT FAIL. Printer output should be similar to that below:

```
TEST:    1-2
FAIL      2PASS      0
CORRECT 001001001001
PIN
STATE 1>100100100100
FAIL PIN:   1   4   7
  10  13  16  19  22
```

e. Measure voltages on indicated Fail Pins. Voltage should be +7.5V ±25 mV.

f. Press ADVANCE TO NEXT FAIL. Printer output should be similar to that below:

```
TEST:    2-3
FAIL      2PASS      0
CORRECT 111111111111
PIN
STATE 1>111111111111
FAIL PIN:   2   5   8
  11  14  17  20  23
```

g. Measure voltage on indicated Fail Pins. Voltage should be +7.5V ±25 mV.

h. Press ADVANCE TO NEXT FAIL. Printer output should be similar to that below:

```
TEST:    2-3
FAIL      2PASS      0
CORRECT 010010010010
PIN
STATE 1>010010010010
FAIL PIN:   2   5   8
  11  14  17  20  23
```

i. Measure voltage on indicated Fail Pins. Voltage should be +7.5V ±25 mV.

j. Press ADVANCE TO NEXT FAIL. Printer output should be similar to that below:

```
TEST:   3-4
FAIL     2PASS     0
CORRECT 111111111111
PIN
STATE 1>111111111111
FAIL PIN:  3   6   9
  12  15  18  21  24
```

k. Measure voltage on indicated Fail Pins. Voltage should be +7.5V ±25 mV.

l. Press ADVANCE TO NEXT FAIL. Printer output should be similar to that below:

```
TEST:   3-4
FAIL     2PASS     0
CORRECT 100100100100
PIN
STATE 1>001001001001
FAIL PIN:  3   6   9
  12  15  18  21  24
```

m. Measure voltage on indicated Fail Pins. Voltage should be +7.5V ±25 mV.

4-134. Failure Detection Circuitry Check

4-135. The Failure Detection Check verifies that a failing device under test can activate the 5045A's failure circuitry. The test uses a precision resistor package (HP P/N 05045-60042) to set up failing conditions for voltage and current. Source and load parameters are tested for each pin. The tests are as follows:

Test 1 Even Pins "Source" Logic 1
Odd Pins "Load" Logic 0

Test 2 Even Pins "Load" Logic 0
Odd Pins "Source" Logic 1

Test 3 Even Pins "Load" Logic 1
Odd Pins "Source" Logic 0

Test 4 Even Pins "Source" Logic 0
Odd Pins "Load" Logic 1

a. Set 5045A front panel switches as in paragraph 4-38 c. except:

ON FAILURE — CONTINUE

b. Load "R-Pack Fail Detect Check 24" or "R-Pack Fail Detect Check 16" for 24-pin or 16-pin instrument. These programs are included in the Operational Verification Card Set. Press TEST. PASS light should illuminate and no printout will be produced. Note: R-Pack is *not* installed for this part of the test.

c. Now install R-Pack in test socket and connect ground lead to TP25 (marked ⏚). Secure R-Pack with locking lever. Press TEST. Printout should begin. For all four tests, verify that every pin is listed in the FAIL PIN information. For 16-pin instruments, pins 1-16 should fail. For 24-pin instruments, pins 1-24 should fail. If any pin is not listed in any or all of the tests, then there may be a problem with the failure detect circuitry for that pin. If this occurs, reinsert the R-Pack and run the test again. If problem still occurs, refer to Troubleshooting in Section VIII.

4-136. V AND I RESULTS — VOLTMETER/AMMETER PRINTOUT CHECK

4-137. This test verifies that the V and I RESULTS printout feature is working properly. The voltage specification is verified by applying an external voltage standard to each of the pins and observing the computed prinout. The current specifications check uses the Resistor Pack (also used in part V). A known current is produced by applying a specified voltage across each 1K resistor in the R-Pack. The resultant current is then computed and printed by the tester. The last part of the V/I check verifies that the voltmeter circuity has minimum offset.

CAUTION

Always adjust the power supply to the approximate test range before applying to the IC tester. Damage to the 5045A may result if voltage magnitudes exceeding 7V are applied to the Test Head.

4-138. Voltage Printout Feature

CAUTION AGAIN

Do not connect the power supply until the correct voltage is set up. Damage to the IC Tester may result if excessive voltage is applied to the Test Head pins.

a. Turn on power supply and set voltage to +4.99V ±5 mV. Connect negative (-) side to A30 TP25 (⏚).

b. Install R-Pack in the 24 pin Test Head socket. Do not connect the black ground lead at this time.

c. Set Front Panel Switches as follows:

START — MAN/HNDLR
ON FAIL — Hold
V and I RESULTS — OFF (DOWN)
Printer — ON

d. Load "V/I Results Voltage Check 16" or "V/I Results Voltage Check 24". Make sure that the correct program card is used (16-pin or 24-pin version).

e. Press Test. The "+4.99 Setup" printout will be produced.

f. Connect Power Supply Positive lead (+) to R-Pack black ground lead.

g. Measure Voltage on TP8 and adjust Power Supply as necessary to produce 5.000V ±5 mV.

h. Set V and I RESULTS — ON (switch UP).

4-139. V/I 5V Verification

a. Press ADVANCE TO NEXT FAIL.

b. A printout similar to the following will be produced (partial printout).

```
TEST:    +5V VERIF
FAIL      5PASS      0
17       6LV   >0.01 MA
17   4.99 V    0.01LMA
18       6LV   >0.01 MA
18   4.99 V    0.01LMA
19       6LV   >0.01 MA
19   4.99 V    0.01LMA
20       6LV   >0.01 MA
20   4.99 V    0.01LMA
21       6LV   >0.01 MA
21   4.99 V    0.01LMA
22       6LV   >0.01 MA
22   4.99 V    0.01LMA
23       6LV   >0.01 MA
23   4.99 V    0.01LMA
24       6LV   >0.01 MA
24   4.99 V    0.01LMA
CORRECT 111111111111
PIN
STATE 1>111111111111
FAIL PIN:  1   2   3
   4   5   6   7   8
   9  10  11  12  13
  14  15  16  17  18
  19  20  21  22  23
  24
```

NOTE

Each pin number has two listings. Voltage levels are listed on the left side of the printout. All parameters containing "L" should be ignored. In this test, only the lower printout for each pin is of importance.

c. For each pin, verify that the printout reads:

5V ±.03V (4.97V, 5.03V)
.04V (4.96V, 5.04V)

4-140. V/I -5V Verification

a. Disconnect Power Supply leads.

b. Set:

V AND I RESULTS — OFF (DOWN)

c. Press ADVANCE TO NEXT FAIL. The "-4.99V setup" printout will be produced.

d. Connect Power Supply leads so that -4.99V is applied to the R-Pack black lead.

e. Measure Voltage on ~~TP24~~ TP8. If necessary, adjust Power Supply to produce -5.00V ±5 mV on TP8.

f. Set:

V and I RESULTS — ON (UP)

g. Press ADVANCE TO NEXT FAIL — wait for printout.

h. Observe voltage printout for each pin.

i. For each pin, verify that the printout reads:
.04V (-4.96V, -5.04V)
-5V ±.03V (-4.97V, -5.03V)

4-141. V/I +1V Verification

a. Disconnect Power Supply leads.

b. Set:

V AND I RESULTS — OFF (DOWN)

Printer — ~~OFF~~ ON

c. Press ADVANCE TO NEXT FAIL. The "+0.99 Setup" printout will be produced.

d. Connect Power Supply leads so that +0.99V is applied to the R-Pack black lead.

e. Measure voltage on TP8. If necessary, adjust Power Supply to produce +1.00V ±5 mV on TP8.

f. Set:

V AND I RESULTS — ON (UP)

g. Press ADVANCE TO NEXT FAIL — wait for printout.

h. Observe voltage printout for each pin.

i. For each pin, verify that the printout reads:

+1V ±.02V (+0.98, +1.02)

4-142. V/I - 1V Verification

a. Disconnect Power Supply leads.

b. Set:

V AND I RESULTS — OFF (DOWN)

Printer — OFF

c. Press ADVANCE TO NEXT FAIL. The "-0.99 Setup" printout will be produced.

d. Connect Power Supply leads so that -0.99V is applied to the R-Pack black lead.

e. Measure voltage on TP8. If necessary, adjust Power Supply to produce -1.00V ±5 mV on TP8.

f. Set:

V AND I RESULTS — ON (UP)

g. Press ADVANCE TO NEXT FAIL — wait for printout.

h. Observe voltage printout for each pin.

i. For each pin, verify that the printout reads:

-1V ±.02V (-0.98, -1.02)

4-143. V/I Results Current Check

a. Disconnect Power 5upply from Test Head.

b. Turn off 5045A.

c. Leave R-Pack installed in test socket and connect R-Pack black lead to A30 TP25 (⏚).

4-144. V/I 7 mA Verification

a. Turn on 5045A.

b. Load "V/I Results Current Check 16" or "V/I Results Current Check 24". Make sure that the correct program card is used (16-pin or 24-pin version).

c. Set:

V and I RESULTS — ON (UP)

Printer — ON

d. Press TEST.

e. A printout similar to the following will be produced (partial printout).

```
TEST:   +7MA VERIF.
 (6.55/7.45)
FAIL      2PASS      0
17  6.93 V       7LMA
18      7LV    7.08 MA
18  6.97 V       7LMA
19      7LV    7.04 MA
19  7.01 V       7LMA
20      7LV    7.08 MA
20      7 V      7LMA
21      7LV    7.08 MA
21  6.95 V       7LMA
22      7LV    7.08 MA
22  6.98 V       7LMA
23      7LV    7.12 MA
23  6.91 V       7LMA
24      7LV    7.04 MA
24  6.98 V       7LMA
CORRECT 111111111111
PIN
STATE 1>111111111111
FAIL PIN:  1   2   3
   4   5   6   7   8
   9  10  11  12  13
  14  15  16  17  18
  19  20  21  22  23
  24
```

Note

Each pin has two listings. The only parameter of interest is the top current printout (right column). Ignore the information in the left column. Also, ignore the right-column current containing the "L".

Verify that the current printout for each pin reads 7 mA ±0.45 mA (6.55/7.45).

4-145. V/I -7 mA Verification

a. Press ADVANCE TO NEXT FAIL.

b. A printout similar to that obtained in paragraph 4-144e will be produced.

c. Observe current printout for each pin (as in paragraph 4-144e).

d. For each pin, verify that the printout leads -7 mA ±0.45 mA (-6.55/-7.45).

4-146. V/I OFFSET CHECK

a. Load "V/I OFFSET CHECK 16" or "V/I OFFSET CHECK 24". Make sure that the correct program card is used (16-pin or 24-pin version). **REMOVE R-PACK.**

b. For 16-pin instruments, pins 6 and 7 should be shorted together with a short length of wire. The short may be mounted in the 24-pin test socket.

4-147. V/I Pos Offset

a. Press TEST.

b. A printout similar to that in paragraph 4-144e will be produced.

c. Observe voltage (left column) for each *failed* pin (as in paragraph 4-144e).

d. For each *failed* pin, verify that the voltage printout reads:

0.00V ±10 mV (-.01, .01)

4-148. V/I Neg Offset Check

a. Press ADVANCE TO NEXT FAIL.

b. Observe voltage (left column) printout for each failed pin (as in paragraph 4-144e).

c. For each *failed* pin, verify that the voltage printout reads:

0.00 +10 mV (-.01, .01)

4-149. Fast Edge Check

4-150. The Fast Edge Check is a verification of positive and negative rise times for analog voltage levels being applied to the IC under test. If during the check, the FAIL lamp illuminates and a printout occurs, press TEST twice to continue. This is usually caused by shorting two pins together.

a. Set the 5045A front panel switches as in paragraph 4-38c.

b. Load "Pos Fast Edge Check".

c. Insert R-Pack in test socket and connect ground lead to A30 TP25 (marked ⏚). Also connect scope ground to A30 TP25 (marked ⏚).

Oscilloscope Setup:

Single Trace: CH A
Trigger Slope: POS
Vertical: 0.1V Div with 10X Probe
Horizontal: 0.1 μsec/div

Note

The display for this fast waveform will be easier to examine with the use of a viewing hood.

d. Connect scope probe to A30 TP1.

Press TEST. The TEST Light should illuminate and there should be no printer output.

Observe the scope display and compare to Figure 4-2.

Rise time: -2V to +2V; 120 nsec max
Overshoot: Less than 0.8V

Move the probe to TP2 and again observe the waveform. Repeat this for all pins. Note that on 16 pin instruments, TP9 through TP16 will have no output and should not be observed.

e. Load "Neg Fast Edge Check".

Change scope trigger to Neg slope.

f. Press TEST.

Observe the waveform as done in the Positive Fast Edge Check. Compare the scope displays to Figure 4-3.

Fall Time; +2V to -2V: 120 nsec max
Overshoot: less than 0.8V

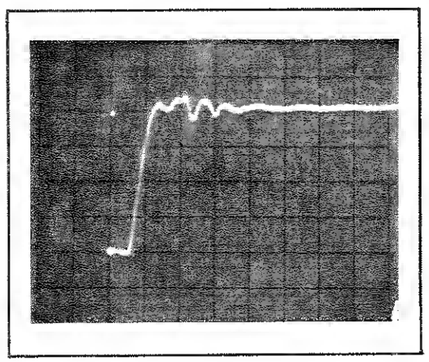


Figure 4-2. Fast Edge Check (Positive)

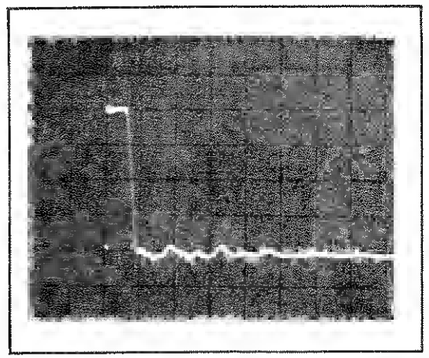


Figure 4-3. Fast Edge Check (Negative)

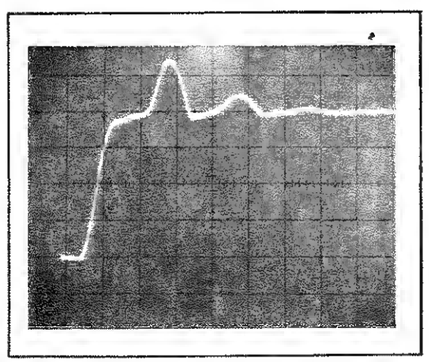


Figure 4-4. Positive Edge .1V Div/.1 µsec With Test Head Extender Cable

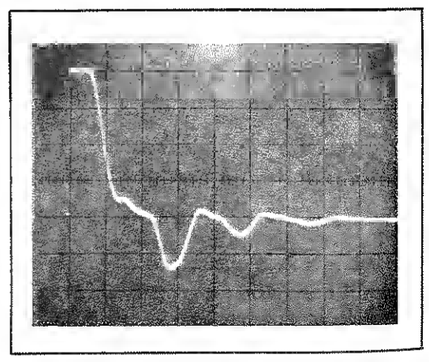


Figure 4-5. Negative Edge .1V Div/.1 µsec With Test Head Extender Cable

4-151. Fast Edge Signals for Extended Test Heads

4-152. The Fast Edge signals for test heads using the tongue extender cables are slightly altered. Figures 4-4 and 4-5 are typical waveforms expected after the positive and negative fast edge checks.

4-153. Relays Check

4-154. The Relays Check insures proper operation of the test head grounding and bypass capacitor relays.

a. Set 5045A front panel switches as in paragraph 4-38c. Note: make sure that the ON FAILURE switch is in the "HOLD" position.

b. Load appropriate "Relays Check" magnetic card; 16-PIN for a standard instrument or 24-PIN for an Option 024 instrument. Printer output should be one of the following:

```
RELAYS CHECK-16 PINS        RELAYS CHECK-24 PINS
```

c. Press TEST. Printer output should be as follows:

(16-pin)

```
TEST:   K1 OK
FAIL     1PASS      0
CORRECT 11111111
PIN
STATE 1>11111111
FAIL PIN: 12
```

(24-pin)

```
TEST:   K1 OK
FAIL     1PASS      0
CORRECT 111111111111
PIN
STATE 1>111111111111
FAIL PIN: 20
```

d. Press ADVANCE TO NEXT FAIL. Printer output should be as follows:

(16-pin)

```
TEST:   K2 OK
FAIL     1PASS      0
CORRECT 11111111
PIN
STATE 1>11111111
FAIL PIN: 13
```

(24-pin)

```
TEST:   K2 OK
FAIL     1PASS      0
CORRECT 111111111111
PIN
STATE 1>111111111111
FAIL PIN: 21
```

e. Press ADVANCE TO NEXT FAIL. Printer output should be as follows:

(16-pin)

```
TEST:   K8 OK
FAIL     1PASS      0
CORRECT 11111111
PIN
STATE 1>11111111
FAIL PIN:  8
```

(24-pin)

```
TEST:   K4 OK
FAIL     1PASS      0
CORRECT 111111111111
PIN
STATE 1>111111111111
FAIL PIN: 10
```

f. Press ADVANCE TO NEXT FAIL. Printout output should be as follows:

(16-pin)

```
TEST:   K9 OK
FAIL     1PASS     0
CORRECT 11111111
PIN
STATE 1>11111111
FAIL PIN:  7
```

(24-pin)

```
TEST:   K7 OK
FAIL     1PASS     0
CORRECT 111111111111
PIN
STATE 1>111111111111
FAIL PIN:  9
```

g. Press ADVANCE TO NEXT FAIL. Printer output should be as follows:

(16-pin final check)

```
TEST:   K11 OK
FAIL     1PASS     0
CORRECT 11111111
PIN
STATE 1>11111111
FAIL PIN:  1
```

(24-pin)

```
TEST:   K8 OK
FAIL     1PASS     0
CORRECT 111111111111
PIN
STATE 1>111111111111
FAIL PIN:  8
```

h. Press ADVANCE TO NEXT FAIL. Printer output should be as follows:

(24-pin)

```
TEST:   K9 OK
FAIL     1PASS     0
CORRECT 111111111111
PIN
STATE 1>111111111111
FAIL PIN:  7
```

i. Press ADVANCE TO NEXT FAIL. Printer output should be as follows:

(24-pin)

```
TEST:   K11 OK
FAIL     1PASS     0
CORRECT 111111111111
PIN
STATE 1>111111111111
FAIL PIN:  1
```

j. Press ADVANCE TO NEXT FAIL. Printer output should be as follows:

(24-pin)

```
TEST:   K12 OK
FAIL     1PASS     0
CORRECT 111111111111
PIN
STATE 1>111111111111
FAIL PIN: 12
```

4-155. Op Code Check

4-156. The Op Code Check verifies program capabilities for logic and arithmetic functions within the Arithmetic Logic Unit of the 5045A's CPU.

a. Set front panel switches as in paragraph 4-38c.

b. Load "OP CODE CHECK".

Press TEST.

PASS light should illuminate and there should be no printer output.

4-157. Printer Check

a. Set front panel switches as in paragraph 4-38c.

b. Load "Printer Check".

Press TEST. The following printout will be produced:

```
TEST:   @ABCDEFGHIJK
LMNOPQRSTUVWXYZ [\]↑
_!"#$%&'()*+,-./0123
456789:;<=>?
EEEEEEEEEEEEEEEEEEEE
FAIL     1PASS     0
CORRECT 111111111111
PIN
STATE 1>111111111111
FAIL PIN:  1
```

c. Check vertical print spacing. Ideal spacing should be about 6 characters per inch. If adjustment is necessary, refer to printer adjustments (Paragraph 8-40i).

4-158. Automatic IC Handler Signals Check (Optional)

4-159. Control signals for automatic IC handlers are generated by circuitry within the 5045A IC Tester. The following procedure is a verification of the timing relationships for these signals.

4-160. The test requires the use of a known good TTL IC and its corresponding Pass/Fail Program Card. The 7400 Quad Nand gate is recommended. This IC is used to test the PASS, FAIL CONTINUITY, and FAIL FUNCTION signals.

4-161. In order to gain easy access to the signal lines, a test cable should be used. The test cable connector and pin-out is listed below.

4-162. Cable

4-163. The test cable is made up of connector (HP Part Number 1251-0142) or Amphenol 5730140) with test wires connected as follows:

$\overline{\text{EOT}}$ — Pin 2

$\overline{\text{FAIL CONT}}$ — Pin 1

$\overline{\text{FAIL FUNCTION}}$ — Pin 11

$\overline{\text{PASS}}$ — Pin 9

GND — Pin 6, 13

4-164. Procedure

a. Hook up handler control test cable to rear of 5045A. Connect scope CH A to the $\overline{\text{EOT}}$ line. Set up scope as follows:

Trigger: CH A, Negative Slope

Vertical:— 2V/div

Horizontal:— 10 msec/div

Ground: Connect to pin 6 or 13 on J15 cable

b. Set 5045A Front Panel switches as follows:

5TART — AUTO
ON FAILURE — END
V and I RESULT5 — OFF (DOWN)
PRINTER — OFF

c. Turn on 5045A and install 7400 IC (or equivalent) in the test head socket. (The 20-pin adapter must be used.)

d. Load the test program.

e. Adjust scope trigger until the $\overline{\text{EOT}}$ signal stabilizes. Using the horizontal position control, move the signal so that beginning of trace is in a convenient location. Verify that the $\overline{\text{EOT}}$ signal is low for about 65 ms (see Figure 4-6).

f. Connect the CH B probe to the $\overline{\text{PA55}}$ line. Compare the signal to that shown in Figure 4- . Verify that the $\overline{\text{PA55}}$ signal goes high after 30 ms ±5 msec (referenced to beginning of $\overline{\text{EOT}}$ trace).

g. Lift the test IC so that the front panel "CONT" light flashes. (The "FAIL" light will also flash.)

h. Connect the CH B Probe to the $\overline{\text{FAIL CONT}}$ line (pin 1 on the J5 cable). Compare the signal to that shown in Figure 4-6. Verify that the $\overline{\text{FAIL CONT}}$ signal goes high after 30 msec ±5 msec (referenced to beginning of $\overline{\text{EOT}}$ Trace).

i. Reinsert the test IC in the test head socket. Connect the CH B Probe to the $\overline{\text{FAIL FCN}}$ line (pin 11 on the J5 cable). Use a screwdriver or similar tool to short pins 1 and 2 of the test IC together. Hold the short condition throughout this portion of the test. Verify that the "FAIL" light is flashing.

j. Compare the signal displayed to that shown in Figure 4-6. Verify that the $\overline{\text{FAIL FCN}}$ signal goes high after 65 msec ±5 msec (referenced to beginning of $\overline{\text{EOT}}$ trace).

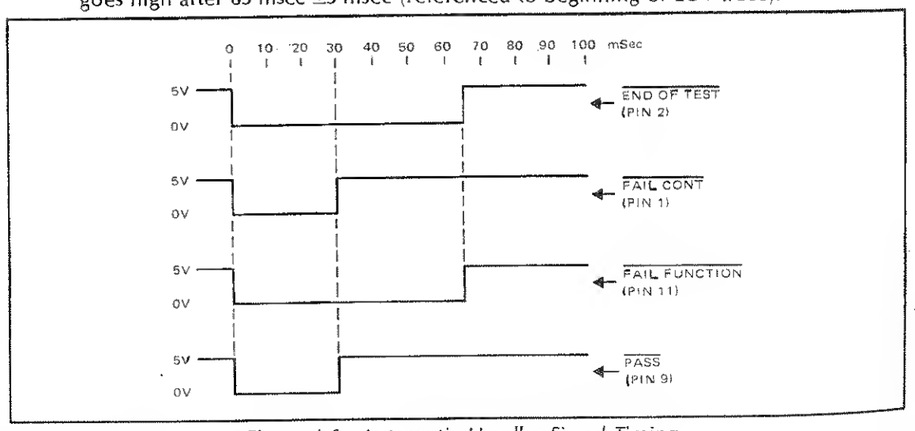


Figure 4-6. Automatic Handler Signal Timing

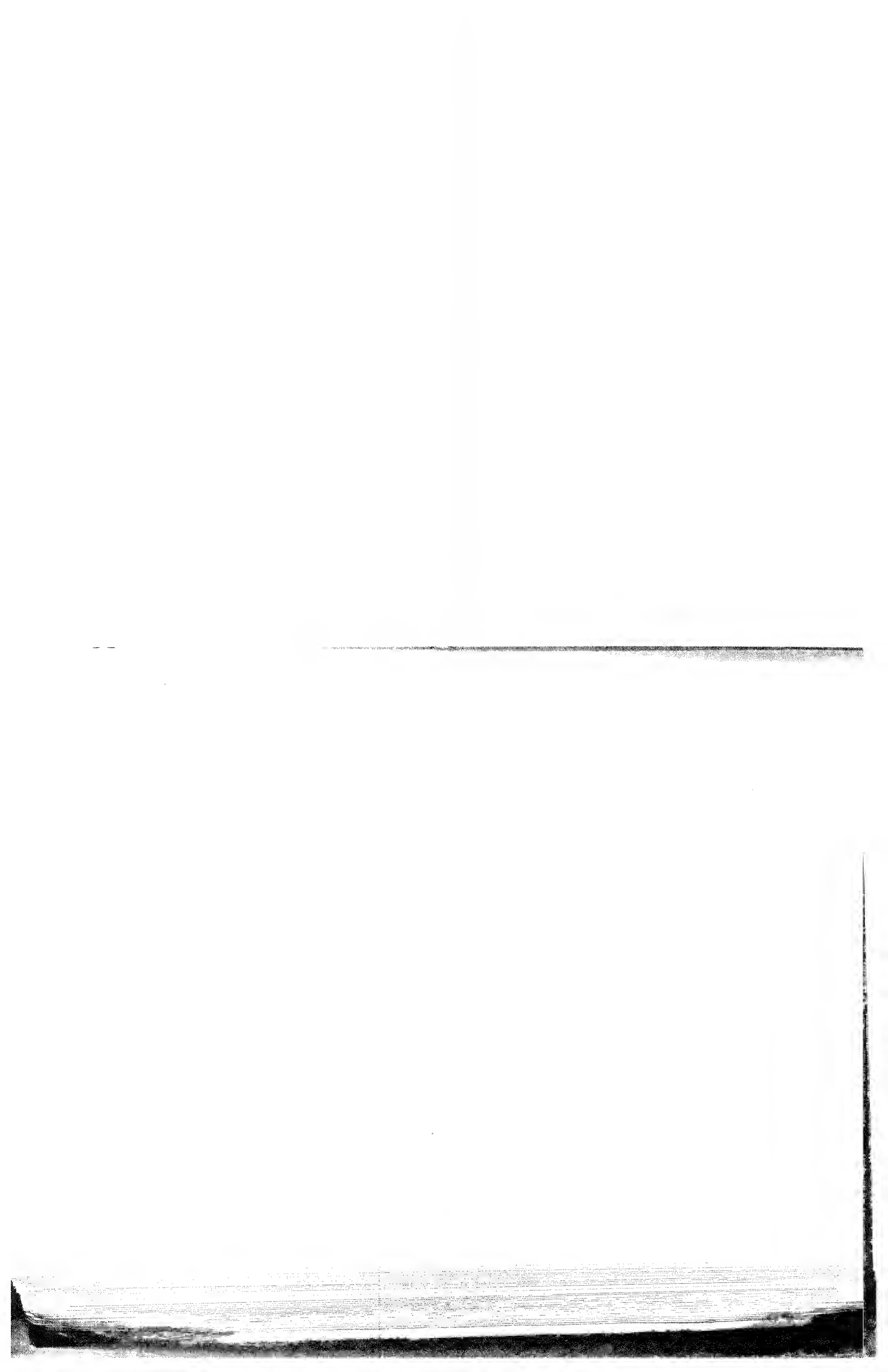
Performance Test Check Card

HEWLETT-PACKARD MODEL 5045A
IC TESTER

SERIAL NO. _____

Test Performed _____
Date _____

DESCRIPTION	CHECK
1. Reference Level Generator Check (DAC)	_____
2. Analog Voltage Check	_____
3. Analog Current Check	_____
4. Cross Talk	_____
5. Failure Detect Check	_____
6. V and I Results Check	_____
7. Fast Edge Check	_____
8. Relays Check	_____
9. Op Code Check	_____
10. Printer Check	_____
11. Automatic IC Handler Signals Check	_____



SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

5-2. This section contains a list of test equipment required and adjustment procedures.

NOTE

All of the adjustments are written for 5045A's equipped with Option 024 (24-pin). For standard instruments, disregard any reference to test points 9 through 16.

5-3. TEST EQUIPMENT REQUIRED

5-4. Table 5-1 lists the equipment required for adjustments. See Table 1-3 for a complete listing of test equipment required for instrument maintenance.

Table 5-1. Required Test Equipment

Instrument Type	Required Characteristics	Recommended Model No.
Oscilloscope	50 MHz	HP 1707B
Vertical	50 mV/div sensitivity, >5 ns rise time	
Horizontal	10 ns/div bandwidth	
Voltmeter/Ammeter, Digital DC	**Voltage:** 20V max 1 mV Resolution on 6.5V level **Current:** 10 μA, 20 mA 100 μA Resolution on 10 mA level .1 μA Resolution on 10 μA level	HP 3465A

5-5. ADJUSTMENTS

5-6. This section contains checkout and adjustment procedures for the power supplies, 4 MHz clock, printer group enable timing, and DAC alignment. These procedures should be performed in the order given, however the adjustments for the DAC should only be performed when there is an indication that an adjustment is necessary rather than on a periodic basis.

5-7. Standard Front Panel Switch Settings

5-8. Prior to performing adjustments or performance tests, set the front panel switches as follows:

START ..... MAN/HNDLR
ON FAILURE ..... HOLD
V AND I RESULTS ..... DOWN
PRINTER ..... ON

5-9. POWER SUPPLY CHECK AND ADJUSTMENTS

5-10. There are four adjustable power supplies and seven supplies which are not adjustable. The supplies should be checked without a program loaded. To check and adjust the power supplies, proceed as follows:

WARNING

LOCATIONS AT LINE VOLTAGE ARE EXPOSED WHEN THE TOP COVER IS REMOVED AND POWER IS APPLIED. AVOID ELECTRICAL SHOCK. SERVICE AND ADJUSTMENTS SHOULD BE COMPLETED BY QUALIFIED SERVICE PERSONNEL.

a. Disconnect primary power from the instrument. Set the front panel switches as per paragraph 5-8.

b. Remove top cover from IC tester.

c. Remove power supply cover.

d. Apply power to the 5045A. Be sure the rear panel line selector settings matches the line voltage.

e. Connect digital voltmeter and oscilloscope to each supply shown in the following table. Board assembly numbers, test points and adjustment locations for the power supplies are marked on the power supply cover. Measure each supply using the chassis in the vicinity of power supply as ground. Adjust as required.

f. Set front panel switch to MAN/HNDLR. Load any program card **BUT DO NOT PRESS TEST.**

g. Again measure the supplies and compare tolerances against the table shown below. When necessary, perform adjustments on the adjustable supplies.

Power Supply Voltages, Tolerances, and 120 Hz Ripple

Voltage	Assembly and Adjustment		Tolerances	120 Hz Ripple
+15	A1	None	±.75V	<100 mV
-15	A1	None	±.5V	<100 mV
+18	A1	None	±.9V	<100 mV
-18	A1	R2	±.2V	<100 mV
+8	A2	R2	±.2V	<100 mV
-8	A2	R3	±.2V	<100 mV
+12	A2		±.6V	<100 mV
-12	A2		±.5V	<150 mV
+5	A3	R3	±.05V	<200 mV
-5	A3		±.25V	<200 mV
+18	A3		±2V	<200 mV

h. Using an oscilloscope, measure the ripple on each supply and verify that the tolerances are met.

NOTE

Re-install power supply cover before proceeding with other measurements.

5-11. A9 4 MHz CLOCK CHECK AND ADJUSTMENT

a. Connect frequency counter to A9TP4. Check that frequency is 4 MHz ±.01 MHz, if not adjust A9R4 for proper frequency.

5-12. PRINTER GROUP ENABLE TIMING ADJUSTMENT

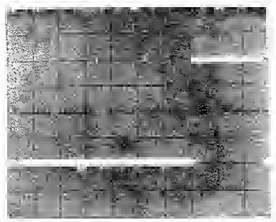
a. Set front-panel switches as follows:

START switch ..... AUTO
ON FAILURE switch ..... CONTINUE
PRINTER switch ..... ON

b. Load "DAC REF CHECK" magnetic card.

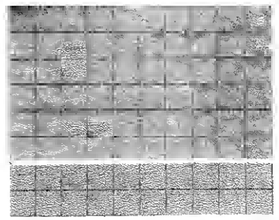
c. Using a 10:1 divider probe, connect oscilloscope to A26U2(7). Connect ground lead to A26U2(8).

d. Set oscilloscope to .1 V/division and horizontal sweep to 1 msec/ division. Check that time between positive pulses (period) is 7 msec ±1 msec, if not, adjust A26R21 for proper period. See Figure A and B for proper waveform.



1 V/cm, 5 msec/div

Figure A



1 V/cm, 1 msec/div

Figure B

NOTE

The remaining adjustments should only be performed when there is an indication that adjusting is necessary rather than on a periodic basis.

5-13. A11 DAC VOLTAGE ADJUSTMENT

5-14. The A11 Adjustment Procedure requires the use of five pre-programmed magnetic test cards which are included in the Diagnostic Card Kit. These cards are:

"DAC REF CHECK"
"+/-V ZERO ADJUST"
"DAC V GAIN ADJUST"
"CURRENT GEN. PRESET ADJUST"
"+/- I ZERO 1-2 ADJUST"

5-15. Proper alignment of the A11 Reference Level Board depends on careful execution of the following procedure. During the adjustments, it will be necessary to record some measurements and make simple averaging calculations. A hand held calculator or scratch paper will be useful.This precise alignment technique is necessary to insure proper DAC offset and linearity. *Note: Allow the 5045A to warm up for at least 20 minutes before making any A11 Reference Level Generator Adjustments.*

5-16. The A11 Reference Level Generator (DAC) Adjustments are performed in 3 steps:

a. DAC Reference Adjustment
b. Voltage Generator Adjustment
c. Current Generator Adjustment

NOTE

All of the tests refer to 24-pin instruments. For 16-pin instruments, test points 9-16 will have no outputs and should not be measured.

5-17. **DAC REF Adjustment**

a. Set 5045A Front Panel 5witches:

START —— MAN/HNDLR
ON FAILURE —— HOLD
V and I RESULT5 —— DOWN
PRINTER —— ON

b. Load **"DAC REF CHECK"**
c. Remove Test Head Cover.
d. Connect DVM ground lead on A30 TP25 (labeled ⏚).
e. Center all pots on the A11 board.
f. Press **TEST**. Measure voltage on A30 TP8. Adjust A11 "**REF**" pot for 7.5V ±5 mV.

5-18. Voltage Generator Adjustment

5-19. *Note: Scratch paper or a Calculator will be useful.* Some of the adjustments involve splitting voltage differences with the **+V ZERO 1** and **-V ZERO 1** pots (located on A11). Table 5-2 serves as an aid in recording measurements and calculating these differences. Make a copy of the table and fill it in as measurements are made. (Make a blank copy because the table may have to be used more than once.)

a. **+V ZERO** 2 Adjustment

Set Front Panel Switches as in paragraph 5-17 (a).

Load "+/-**V ZERO 2 ADJUST.**"

Connect DVM ground lead to A30 TP25.

b. Press **TEST**. The following printout will be produced:

```
TEST:   +V ZERO 2 0V
FAIL      1PASS      0
CORRECT 111111111111
PIN
STATE 1>111111111111
FAIL PIN:  1   2   3
   4   5   6   7   8
   9  10  11  12  13
  14  15  16  17  18
  19  20  21  22  23
  24
```

c. Measure **+V ZERO 2** pot to produce 0.00 ±5 mV on pin 8. Then verify that all other pins measure 0.00V ±10 mV.

d. **-V ZERO 2** Adjustment

Press **ADVANCE TO NEXT FAIL**. The following printout will be produced:

```
TEST:   -V ZERO 2 0V
FAIL      1PASS      0
CORRECT 000000000000
PIN
STATE 1>000000000000
FAIL PIN:  1   2   3
   4   5   6   7   8
   9  10  11  12  13
  14  15  16  17  18
  19  20  21  22  23
  24
```

e. Adjust **-V ZERO 2** pot to produce 0.00 ±5 mV on pin 8. Then verify that all other pins measure 0.00V ±10 mV.

f. **+V GAIN (+6.5V)** Adjustment

Load **"DAC V GAIN ADJUST"**

g. Press **TEST**. The following printout will be produced:

```
TEST:   +V GAIN
(+6.5V)
FAIL      1PASS      0
CORRECT 111111111111
PIN
STATE 1>111111111111
FAIL PIN:  1   2   3
   4   5   6   7   8
   9  10  11  12  13
  14  15  16  17  18
  19  20  21  22  23
  24
```

h. Adjust **+V GAIN** pot to produce 6.5V ±2 mV on pin 8.

i. **-V GAIN (-6.5V)** Adjustment

Press **ADVANCE TO NEXT FAIL.** The following printout will be produced:

```
TEST:   -V GAIN
(-6.5V)
FAIL      1PASS      0
CORRECT 000000000000
PIN
STATE 1>000000000000
FAIL PIN:   1   2   3
   4   5   6   7   8
   9  10  11  12  13
  14  15  16  17  18
  19  20  21  22  23
  24
```

j. Adjust **-V GAIN** pot to produce -6.5V ±2 mV on pin 8.

The following measurements involve splitting voltage differences. Use Table 5-2 as an aid in making calculations. Table 5-3 is an example of typical measurements. It will be helpful to study Table 5-3 before proceeding.

k. **+V ZERO 1 (-6.5V)**

Press **ADVANCE TO NEXT FAIL.** The following printout will be produced:

```
TEST:   +V ZERO 1
(-6.5V)
FAIL      1PASS      0
CORRECT 111111111111
PIN
STATE 1>111111111111
FAIL PIN:   1   2   3
   4   5   6   7   8
   9  10  11  12  13
  14  15  16  17  18
  19  20  21  22  23
  24
```

l. Measure the voltage on pin 8 and record it under column A of Table 5-2 (line 1). Calculate the **DIFFERENCE** between -6.5V and the voltage recorded in A. For example (Table 5-3), if column A has -6.580, then the **DIFFERENCE** (.080V) is entered in column B. Next, enter 1/2 the difference in the "**HALF DIFF**" column. In the example this "**HALF DIFF**" is .040V. In the **+V ZERO 1** Adjustment Column, enter the voltage from A plus the "**HALF DIFFERENCE**". In other words, split the difference between the voltage recorded in Column A and -6.5V by adjusting the **+V ZERO 1** pot. In the example, -6.540V is entered. Note that the adjustment to **+V ZERO 1** should always bring the output voltage **closer** to -6.5V level. If the adjustment moves the output further from -6.5V, then a **sign error** has been made in the calculations. Now that the desired **+V ZERO 1** adjustment has been calculated, adjust the **+V ZERO 1** pot for that voltage (pin 8).

m. **-V ZERO 1 (+6.5V)**

Press **ADVANCE TO NEXT FAIL**. The following printout will be produced:

```
TEST:    -V ZERO 1
(+6.5V)
FAIL       1PASS      0
CORRECT 000000000000
PIN
STATE 1)000000000000
FAIL PIN:  1   2   3
    4   5   6   7   8
    9  10  11  12  13
   14  15  16  17  18
   19  20  21  22  23
   24
```

n. Measure voltage on pin 8 and record in Table 5-2 column A (line 2). Use the same procedure for calculating **DIFFERENCE**, **HALF DIFFERENCE**, and **-V ZERO 1** level as was used in Paragraph 5-19 step (l). Note that in this test, the difference between the measured reading in column A and +6.5V must be calculated. After calculating the **-V ZERO 1** level, adjust **-V ZERO 1** pot for that voltage (pin 8).

o. Now that **+V ZERO 1** and **-V ZERO 1** pots have been adjusted, it is necessary to trim the **+V GAIN** and **-V GAIN** levels. Press **TEST** twice. A "**V GAIN (+6.5V)**" printout will be produced. Measure the voltage on pin 8 and record in Table 5-2, column A (line 3). Calculate the "**MAGNITUDE DIFFERENCE**" and enter in column 8. In the "**MAGNITUDE DIFFERENCE**" column, note the two arrows, ↑ and ↓. Do not worry about the sign of the difference. Instead, use the arrows to indicate if the adjustment should increase (↑) or decrease (↓) the parameter in question. An example will help: for the **+V GAIN (+6.5V)** test, suppose a level of 6.542V is measured. This is recorded under column A. The "**MAGNITUDE DIFFERENCE**" is .042V and the adjustment direction is down (↓). Under column 8, .042V is entered and the (↓) arrow is circled. **Make no adjustments at this time.**

p. Press **ADVANCE TO FAIL**. A "**-V GAIN (-6.5V)**" printout will be produced. Measure the voltage on pin 8 and record this level under column A of Table 5-2 (line 4). Determine the "**MAGNITUDE DIFFERENCE**" in the same manner as Paragraph 5-19 step (o). If -6.492V is measured, the "**MAGNITUDE DIFFERENCE**" is .008V. The direction for the "**MAGNITUDE DIFFERENCE**" is up (↑). Therefore, .008V is recorded and the (↓) arrow is circled in the "**MAGNITUDE DIFFERENCE**" column. **Make no adjustments at this time.**

q. Press **ADVANCE TO NEXT FAIL**. A "**+V ZERO 1 (-6.5V)**" printout will be produced. Measure voltage on pin 8. Record level (line 5) and calculate "**MAGNITUDE DIFFERENCE**" as done in Paragraph 5-19 step (p). 8e sure to circle the appropriate arrow. **Make no adjustments at this time.**

r. Press **ADVANCE TO NEXT FAIL**. A "**-V ZERO 1 (+6.5V)**" printout will be produced. Measure voltage on pin 8. Record level (line 6) and calculate "**MAGNITUDE DIFFERENCE**" as done in Paragraph 5-19 step (o). 8e sure to circle the appropriate arrow. **Make no adjustments at this time.**

s. The four "**MAGNITUDE DIFFERENCE**" levels in Table 5-2 are labeled C, D, E, and F. It is now necessary to average these differences and calculate the adjustment required for trimming **+V GAIN** and **-V GAIN**.

t. **+V GAIN AVERAGE** (line 7)

Take the two "**MAGNITUDE DIFFERENCE**" readings from C and E of Table 5-2 and add them. Take this sum and divide by 2 to find the "**AVERAGE DIFFERENCE**". Note that C and E should both have the same arrow direction (↑ or ↓). The "**AVERAGE DIFFERENCE**" should also have the same arrow as C and E. Take the voltage recorded in column A (line 3) and add or subtract "**AVERAGE DIFFERENCE**" as necessary to bring this level **closer** to +6.5V. Press **TEST** twice. Measure voltage on pin 8 and adjust **+V GAIN** pot for the calculated level (should be close to +6.5V).

Use the following example for clarity. Refer to the sample chart, Table 5-3. Note that the "**MAGNITUDE DIFFERENCES**" for C and E are .042 ↓ and .040 ↓ respectively. The "**AVERAGE DIFFERENCE**" is .041V ↓. The **+V GAIN (+6.5V)** level recorded under column A (line 4) is +6.542V. The adjustment for +V gain is therefore 6.542V +.041V ↓ = +6.501V (magnitude addition). In this example, after pressing **TEST**, the **+V GAIN** pot is adjusted to produce +6.501V on pin 8.

u. **-V GAIN AVERAGE** (line 8)

Press **ADVANCE TO NEXT FAIL** and adjust the **-V GAIN** pot for the correct level on pin 8.

Refer to the Sample Test Record, Table 5-3 for an example. The "**MAGNITUDE DIFFERENCE**" is .009V ↑. The **-V GAIN (6.5V)** level recorded under column A (line 4) is -6.492V. The adjustment for the **-V GAIN** pot is therefore 6.492 + .009 ↑ = -6.501V (magnitude addition).

v. It is now necessary to check all 4 levels to insure that the voltage generator is properly aligned. All measurements refer to pin 8.

Press **TEST** twice **+GAIN (+6.5V)**
Measure +6.5V ±10 mV

Press **ADVANCE TO NEXT FAIL -V GAIN (-6.5V)**
Measure -6.5V ±10 mV

Press **ADVANCE TO NEXT FAIL +V ZERO 1 (-6.5V)**
Measure -6.5V ±10 mV

Press **ADVANCE TO NEXT FAIL -V ZERO 1 (+6.5V)**
Measure +6.5V ±10 mV

Note: **Make no adjustments at this time.**

w. **+V ZERO 2** and **-V ZERO 2** Check

Re-checking the ±V Zero 2 adjustments is necessary to insure that the voltage generator still has zero offset.

Repeat Paragraph 5-19 steps (a thru e) and readjust if necessary. If the ±V Zero 2 pots require adjustment, then, after adjusting, repeat step v above. Then proceed to step x.

x. If **any** of the limits measured in step v above could not be met, then a second pass at the voltage adjustments must be made. **DO NOT CENTER ANY OF THE POTS!** The second pass uses the same procedure and fine tunes the adjustments. Perform steps f through w under Paragraph 5-19 if a second pass is necessary. Use a new copy of Table 5-2 and proceed as before.

Verification of Voltage Adjustments

After all adjustments have been made, a verification of performance for all pins must be executed. Use the procedure in step v and w to verify voltage levels for all pins. Make measurements on A30 test points 1-24. If necessary, repeat second pass according to Paragraph 5-19 step x.

Final limits for **all** pins (Test Points 1-24).*

+V GAIN (+6.5V)	+6.5V = 10 mV
-V GAIN (-6.5V)	-6.5V ±10 mV
+V ZERO 1 (-6.5V)	-6.5V ±10 mV
-V ZERO 1 (+6.5V)	+6.5V ±10 mV

**Note: For 16-pin instrument, test points 9-16 will have no outputs and should not be measured.*

5-20. Current Generator Adjustment

Equipment Required:

HP 3465A or equivalent
4-1/2 Digit Current Meter
10 μA, 200 mA Ranges

a. Set front panel switches according to Paragraph 5-17 step (a).

b. Remove Test Gead cover (if not already done). Connect ammeter ground lead to A30TP25 (marked ↓). Set ammeter to measure 10 mA level.

c. Center ±**I ZERO 1** and ±**I ZERO 2** pots (if not already done).

d. Load "**CURRENT GEN. PRESET ADJUST**". Press **TEST**. The following printout will be produced:

```
TEST:    ADJ.+I ZERO2
 FOR +10MA
FAIL      1PASS      0
CORRECT 111111111111
PIN
STATE 1>111111111111
FAIL PIN:  1   2   3
   4   5   6   7   8
   9  10  11  12  13
  14  15  16  17  18
  19  20  21  22  23
  24
```

e. Measure current on pin 8. Adjust +**I ZERO 2** pot to produce 10 mA ±0.2 mA.

f. Press **ADVANCE TO NEXT FAIL**. The following printout will be produced:

```
TEST:   ADJ.-I ZERO2
 FOR -10MA
FAIL      1PASS      0
CORRECT 000000000000
PIN
STATE 1>000000000000
FAIL PIN:  1   2   3
   4   5   6   7   8
   9  10  11  12  13
  14  15  16  17  18
  19  20  21  22  23
  24
```

g. Measure current on pin 8. Adjust **-I ZERO 2** to produce -10 mA ±0.2 mA.

h. Load "+/**-I ZERO 1-2 ADJUST.**" Press **TEST**. The following printout will be produced:

```
TEST:   ADJ.+I ZERO1
 FOR ALL +10UA
FAIL      1PASS      0
CORRECT 111111111111
PIN
STATE 1>111111111111
FAIL PIN:  1   2   3
   4   5   6   7   8
   9  10  11  12  13
  14  15  16  17  18
  19  20  21  22  23
  24
```

i. Measure current and adjust **+I ZERO 1** pot to produce +10 μA ±.1 μA on pin 8. Then verify that all other pins measure +10 μA ±5 μA. If necessary, the spec on pin 8 maybe relaxed to +10 μA ±5 μA to meet tolerance on all other pins.

j. Press **ADVANCE TO NEXT FAIL**. The following printout will be produced:

```
TEST:   ADJ.-I ZERO1
 FOR ALL -10UA
FAIL      1PASS      0
CORRECT 000000000000
PIN
STATE 1>000000000000
FAIL PIN:  1   2   3
   4   5   6   7   8
   9  10  11  12  13
  14  15  16  17  18
  19  20  21  22  23
  24
```

k. Measure current and adjust **-I ZERO 1** pot to produce -10 μA ±.1 μA on pin 8. Then verify that all other pins measure -10 μA ±5 μA. If necessary, the spec on pin 8 may be relaxed to -10 μA ±5 μA to meet tolerance on all pins.

l. Press **ADVANCE TO NEXT FAIL**. The following printout will be produced:

```
TEST:   ADJ,+I ZERO2
 FOR ALL +10UA
FAIL      1PASS      0
CORRECT 111111111111
PIN
STATE 1>111111111111
FAIL PIN:  1   2   3
   4   5   6   7   8
   9  10  11  12  13
  14  15  16  17  18
  19  20  21  22  23
  24
```

m. Measure current and adjust **+I ZERO 2** pot to produce +10 μA $\pm$.1 μA on pin 8. Then verify that all other pins measure +10 μA $\pm$2.5 μA. If necessary, the spec on pin 8 may be relaxed to +10 μA $\pm$2.5 μA to meet tolerance on all pins.

n. Press **ADVANCE TO NEXT FAIL**. The following printout will be produced:

```
TEST:   ADJ,-I ZERO2
 FOR ALL -10UA
FAIL      1PASS      0
CORRECT 000000000000
PIN
STATE 1>000000000000
FAIL PIN:  1   2   3
   4   5   6   7   8
   9  10  11  12  13
  14  15  16  17  18
  19  20  21  22  23
  24
```

o. Measure current and adjust **-I ZERO 2** pot to produce -10μA $\pm$.1 on pin 8. Then verify that all other pins measure -10 μA $\pm$2.5 μA. If necessary, the spec on pin 8 may be relaxed to -10 μA $\pm$2.5 μA to meet tolerance on all pins.

p. **VERIFICATION OF CURRENT ADJUSTMENTS**

Verify that limits are met for all pins.

Note: This step may be deleted if all limits were met under steps h through j above.

Press **TEST +I Zero 1 +10 -A**
Verify: 10 μA $\pm$5 μA

Press **ADVANCE TO NEXT FAIL -I ZERO 1 -10 μA**
Verify -10 μA $\pm$5 μA for all pins.

p. **VERIFICATION OF CURRENT ADJUSTMENTS** (Continued)

Press **ADVANCE TO NEXT FAIL +I Zero 2 +10 μA**
Verify +10 μA ±2.5 μA for all pins.

Press **ADVANCE TO NEXT FAIL -I ZERO 2 -10 μA**
Verify -10 μA ±2.5 μA for all pins.

If all limits cannot be met, then repeat steps h through p above as many times as necessary. DO NOT center the pots when making a second pass through the adjustments.

5-21. Successful completion of the DAC Reference Adjustment, Voltage Generator Adjustment, and Current Generator Adjustment results in proper calibration of the A11 Reference Level Generator (DAC). All Performance Tests should be run in order to verify instrument specs.

TEST SEQUENCE	A MEASURED VOLTAGE	B DIFFERENCE	HALF DIFFERENCE	±V ZERO 1 ADJUSTMENT
Press TEST. Line 1 +V ZERO 1 (-6.5V)	- _____ V	(-6.5V -A) _____ V	(B/2) _____ V	(A + B/2) Adj +V ZERO 1 to _____ V.
Press ADVANCE TO NEXT FAIL Line 2 -V ZERO 1 (+6.5V)	+ _____ V	(+6.5V -A) _____ V	(B/2) _____ V	(A + B/2) Adj -V ZERO 1 to _____ V.
Press TEST. Line 3 +V GAIN (+6.5V)	+ _____ V	C Magnitude Difference _____ ▲ ▼	NOTE: Circle the appropriate arrow (▲ or ▼) to indicate Increase (▲) or Decrease (▼) adjustment. See text.	
Press ADVANCE TO NEXT FAIL Line 4 -V GAIN (-6.5V)	- _____ V	D Magnitude Difference _____ ▲ ▼		
Press ADVANCE TO NEXT FAIL Line 5 +V ZERO 1 (-6.5V)	- _____ V	E Magnitude Difference _____ ▲ ▼		
Press ADVANCE TO NEXT FAIL Line 6 -V ZERO 1 (+6.5V)	+ _____ V	F Magnitude Difference _____ ▲ ▼		
Line 7 +V GAIN AVERAGE	Average = $\frac{C + E}{2}$ Note: C and E should have same arrow direction.	Average _____ V ▲ ▼ Adj + V GAIN to _____ V.		Press TEST. Measure V. Increase ▲ or Decrease ▼ Output by Average.
Line 8 -V GAIN AVERAGE	Average = $\frac{D + F}{2}$ Note: D and F should have same arrow direction.	Average _____ V ▲ ▼ Adj -V GAIN to _____ V.		Press ADVANCE TO NEXT FAIL. Measure V. Increase ▲ or Decrease ▼ Output by Average.

Table 5-2 Blank Test Aid

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains information for ordering replacement parts. Table 6-1 lists parts in alphanumerical order of their reference designators and indicates the description and HP Part Number of each part, together with any applicable notes. The table includes the following information.

a. Description of part (see abbreviations below).

b. Typical manufacturer of the part in a five-digit code; see list of manufacturers in Table 6-2.

c. Manufacturer's part number.

d. Total quantity used in the instrument (Qty column).

REFERENCE DESIGNATIONS

A	= assembly	E	= miscellaneous electrical part	MP	= miscellaneous mechanical part
AT	= attenuator; isolator; termination	F	= fuse	P	= electrical connector (movable portion); plug
B	= fan; motor	FL	= filter		
BT	= battery	H	= hardware		
C	= capacitor	HY	= circulator	Q	= transistor; SCR; triode thyristor
CP	= coupler	J	= electrical connector (stationary portion); jack	R	= resistor
CR	= diode; diode thyristor; varactor			RT	= thermistor
DC	= directional coupler			S	= switch
DL	= delay line	K	= relay	T	= transformer
DS	= annunciator; signaling device (audible or visual); lamp; LED	L	= coil; inductor	TB	= terminal board
		M	= meter	TC	= thermocouple
				TP	= test point
				U	= integrated circuit; microcircuit
				V	= electron tube
				VR	= voltage regulator; breakdown diode
				W	= cable; transmission path; wire
				X	= socket
				Y	= crystal unit-piezo-electric
				Z	= tuned cavity; tuned circuit

ABBREVIATIONS

A	= ampere	BCD	= binary coded decimal	COMP	= composition
ac	= alternating current	BD	= board	COMPL	= complete
ACCESS	= accessory	BE CU	= beryllium copper	CONN	= connector
ADJ	= adjustment	BFO	= beat frequency oscillator	CP	= cadmium plate
A/D	= analog-to-digital			CRT	= cathode-ray tube
af	= audio frequency	BH	= binder head	CTL	= complementary transistor logic
AFC	= automatic frequency control	BKDN	= breakdown		
AGC	= automatic gain control	BP	= bandpass	CW	= continuous wave
AL	= aluminum	BPF	= bandpass filter	cw	= clockwise
ALC	= automatic level control	BRS	= brass	D/A	= digital-to-analog
AM	= amplitude modulation	BWO	= backward-wave oscillator	dB	= decibel
amp	= amplifier			dBm	= decibel referred to 1 mW
APC	= automatic phase control	CAL	= calibrate		
assy	= assembly	ccw	= counterclockwise	dc	= direct current
AUX	= auxiliary	CER	= ceramic	deg	= degree (temperature interval or difference)
avg	= average	CHAN	= channel		
AWG	= american wire gauge	cm	= centimeter	... °	= degree (plane angle)
bal	= balance	CMO	= coaxial	°C	= degree Celsius (centrigrade)
		COEF	= coefficient		
		COM	= common	°F	= degree Fahrenheit
				°K	= degree Kelvin
				DEPC	= deposited carbon
				DET	= detector
				diam	= diameter
				DIA	= diameter (used in parts list)
				DIFF AMPL	= differential amplifier
				div	= division
				DPDT	= double-pole, double-throw
				DR	= drive
				DSB	= double sideband
				DTL	= diode transistor logic
				DVM	= digital voltmeter
				ECL	= emitter coupled logic
				EMF	= electromotive force
				EDP	= electronic data processing
				ELECT	= electrolytic

ABBREVIATIONS (CONTINUED)

ENCAP	= encapsulated
EXT	= external
F	= farad
FET	= field-effect transistor
F/F	= flip-flop
FH	= flat head
FOL H	= fillister head
FM	= frequency modulation
FP	= front panel
FREQ	= frequency
FXD	= fixed
g	= gram
GE	= germanium
GHz	= gigahertz
GL	= glass
GND	= ground(ed)
H	= henry
h	= hour
HET	= heterodyne
HEX	= hexagonal
HD	= head
HDW	= hardware
HF	= high frequency
HG	= mercury
HI	= high
HP	= Hewlett-Packard
HPF	= high pass filter
HR	= hour (used in parts list)
HV	= high voltage
Hz	= Hertz
IC	= integrated circuit
ID	= inside diameter
IF	= intermediate frequency
IMPG	= impregnated
in	= inch
INCD	= incandescent
INCL	= include(s)
INP	= input
INS	= insulation
INT	= internal
kg	= kilogram
kHz	= kilohertz
kΩ	= kilohm
kV	= kilovolt
lb	= pound
LC	= inductance-capacitance
LED	= light-emitting diode
LF	= low frequency
LG	= long
LH	= left hand
LIM	= limit
LIN	= linear taper (used in parts list)
lin	= linear
LK WASH	= lockwasher
LO	= low; local oscillator
LOG	= logarithmic taper (used in parts list)
log	= logarithm(ic)
LPF	= low pass filter
LV	= low voltage
m	= meter (distance)
mA	= milliampere
MAX	= maximum
MΩ	= megohm
MEG	= meg (10^6) (used in parts list)
MET FLM	= metal film
MET OX	= metal oxide
MF	= medium frequency; microfared (used in parts list)
MFR	= manufacturer
mg	= milligram
MHz	= megahertz
mH	= millihenry
mho	= mho
MIN	= minimum
min	= minute (time)
′	= minute (plane angle)
MINAT	= miniature
mm	= millimeter
MOD	= modulator
MOM	= momentary
MOS	= metal-oxide semi-conductor
ms	= millisecond
MTG	= mounting
MTR	= meter (indicating device)
mV	= millivolt
mVac	= millivolt, ac
mVdc	= millivolt, dc
mVpk	= millivolt, peak
mVp-p	= millivolt, peak-to-peak
mVrms	= millivolt, rms
mW	= milliwatt
MUX	= multiplex
MY	= mylar
μA	= microampere
μF	= microfarad
μH	= microhenry
μmho	= micromho
μs	= microsecond
μV	= microvolt
μVac	= microvolt, ac
μVdc	= microvolt, dc
μVpk	= microvolt, peak
μVp-p	= microvolt, peak-to-peak
μVrms	= microvolt, rms
μW	= microwatt
nA	= nanoampere
NC	= no connection
N/C	= normally closed
NE	= neon
NEG	= negative
nF	= nanofarad
NI PL	= nickel plate
N/O	= normally open
NOM	= nominal
NORM	= normal
NPN	= negative-positive-negative
NPO	= negative-positive zero (zero temperature coefficient)
NRFR	= not recommended for field replacement
NSR	= not separately replaceable
ns	= nanosecond
nW	= nanowatt
OBD	= order by description
OD	= outside diameter
OH	= oval head
OP AMPL	= operational amplifier
OPT	= option
OSC	= oscillator
OX	= oxide
oz	= ounce
Ω	= ohm
P	= peak (used in parts list)
PAM	= pulse-amplitude modulation
PC	= printed circuit
PCM	= pulse-code moudulation; pulse-count modulation
PDM	= pulse-duration modulation
pF	= picofarad
PH BRZ	= phosphor bronze
PHL	= Phillips
PIN	= positive-instrinsic-negative
PIV	= peak inverse voltage
pk	= peak
PL	= phase lock
PLO	= phase lock oscillator
PM	= phase modulation
PNP	= positive-negative-positive
P/O	= part of
POLY	= polystyrene
PORC	= porcelain
POS	= positive; position(s) (used in parts list)
POSN	= position
POT	= potentiometer
p-p	= peak-to-peak
PP	= peak-to-peak (used in parts list)
PPM	= pulse-position modulation
PREAMPL	= preamplifier
PRF	= pulse-repetition frequency
PRR	= pulse repetition rate
ps	= picosecond
PT	= point
PTM	= pulse-time modulation
PWM	= pulse-width modulation
PWV	= peak working voltage
RC	= resistance capacitance
RECT	= rectifier
REF	= reference
REG	= regulated
REPL	= replaceable
RF	= radio frequency
RFI	= radio frequency interference
RH	= round head; right hand
RLC	= resistance-inductance-capacitance
RMO	= rack mount only
rms	= root-mean-square
RND	= round
ROM	= read-only memory
R&P	= rack and panel
RWV	= reverse working voltage
S	= scattering parameter
s	= second (time)
″	= second (plane angle)
S-B	= slow-blow (fuse (used in parts list)
SCR	= silicon controlled rectifier; screw
SE	= selenium
SECT	= sections
SEMICON	= semiconductor
SHF	= superhigh frequency
SI	= silicon
SIL	= silver
SL	= slide
SNR	= signal-to-noise ratio
SPDT	= single-pole, double-throw
SPG	= spring
SR	= split ring
SPST	= single-pole, single-throw
SSB	= single sideband
SST	= stainless steel
STL	= steel
SQ	= square
SWR	= standing-wave ratio
-SYNC	= synchronize
T	= timed (slow-blow fuse)
TA	= tantalum
TC	= temperature compensating
TD	= time delay
TERM	= terminal
TFT	= thin-film transistor
TGL	= toggle
THD	= thread
THRU	= through
TI	= titanium
TOL	= tolerance
TRIM	= trimmer
TSTR	= transistor
TTL	= transistor-transistor logic
TV	= television
TVI	= television interference
TWT	= traveling wave tube
U	= micro (10^{-6}) (used in parts list)
UF	= microfarad (used in parts list)
UHF	= ultrahigh frequency
UNREG	= unregulated
V	= volt
VA	= voltampere
Vac	= volts ac
VAR	= variable
VCO	= voltage-controlled oscillator
Vdc	= volts dc
VDCW	= volts dc, working (used in parts list)
V(F)	= volts, filtered
VFO	= variable-frequency oscillator
VHF	= very-high frequency
Vpk	= volts peak
Vp-p	= Volts peak-to-peak
Vrms	= volts rms
VSWR	= voltage standing wave ratio
VTO	= voltage-tuned oscillator
VTVM	= vacuum-tube voltmeter
V(X)	= volts, switched
W	= watt
W/	= with
WIV	= working inverse voltage
WW	= wirewound
W/O	= without
YIG	= yttrium-iron-garnet
Zo	= characteristic impedance

NOTE

All abbreviations in the parts list will be in upper case.

MULTIPLIERS

Abbreviation	Prefix	Multiple
T	tera	10^{12}
G	giga	10^{9}
M	mega	10^{6}
k	kilo	10^{3}
da	deka	10^{1}
d	deci	10^{-1}
c	centi	10^{-2}
m	milli	10^{-3}
μ	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}
f	femto	10^{-15}
a	atto	10^{-18}

6-3. ORDERING INFORMATION

6-4. To obtain replacement parts, address order of inquiry to your local Hewlett-Packard Sales and Service Office (see lists at rear of this manual for addresses). Identify parts by their Hewlett-Packard part numbers.

a. Instrument model number.
b. Instrument serial number.
c. Description of the part.
d. Function and location of the part.

6-5. HP PART NUMBER ORGANIZATION

6-6. Following is a general description of the HP part number system.

6-7. Component Parts and Materials

6-8. Generally, the prefix of HP part numbers identifies the type of device. Eight digit part numbers are used, where the four digit prefix identifies the type of component, part, or material and the four digit suffix indicates the specific type. Following is a list of some of the more commonly used prefixes for component parts. The list includes HP manufactured parts and purchased parts.

Prefix	Component/Part/Material
0121-	Capacitors, Variable (mechanical)
0122-	Capacitors, Voltage Variable (semiconductor)
0140-	Capacitors, Fixed } Non-Electrolytic
0150-	Capacitors, Fixed } Non-Electrolytic
0160-	Capacitors, Fixed } Non-Electrolytic
0180-	Capacitors, Fixed Electrolytic
0330-	Insulating Materials
0340-	Insulators, Formed
0370-	Knobs, Control
0380-	Spacers and Standoffs
0410-	Crystals
0470-	Adhesives
0490-	Relays
0510-	Fasteners
0674- thru 0778-	Resistors, Fixed (non wire wound)
0811- thru 0831-	Resistors (wire wound)
1200-	Sockets for components
1205-	Heat Sinks
1250-	Connectors (RF and related parts)
1251-	Connectors (non RF and related parts)
1410-	Bearings and Bushings
1420-	Batteries
1820-	Monolithic Digital Integrated Circuits
1826-	Monolithic Linear Integrated Circuits
1850-	Transistors, Germanium PNP
1851-	Transistors, Germanium NPN
1853-	Transistors, Silicon PNP
1854-	Transistors, Silicon NPN
1855-	Field-Effect-Transistors
1900- thru 1912-	Diodes

Prefix	Component/Part/Material
1920- thru 1952-	Vacuum Tubes
1990-	Semiconductor Photosensitive and Light-Emitting Diodes
3100- thru 3106-	Switches
8120-	Cables
9100-	Transformers, Coils, Chokes, Inductors, and Filters

6-9. For example, 1854-0037, 1854-0221, and 1851-0192 are all NPN transistors. The first two are silicon and the last is germanium.

6-10. General Usage Parts

6-11. The following list gives the prefixes for HP manufactured parts used in several instruments, e.g., side frames, feet, top and bottom covers, etc. These are eight-digit part numbers with the four-digit prefix identifying the type of parts as shown below:

Type of Part	Prefix
Sheet Metal	5000- to 5019-
Machined	5020- to 5039-
Molded	5040- to 5059-
Assemblies	5060- to 5079-
Components	5080- to 5099-

6-12. Specific Instrument Parts

6-13. These are HP manufactured parts for use in individual instruments or series of instruments. For these parts, the prefix indicates the instrument and the suffix indicates the type of part. For example, 05328-60001 is an assembly used in the 5328A. Following is a list of suffixes commonly used.

Type of Part	P/N Suffix
Sheet Metal	-00000 to -00499
Machined	-20000 to -20499
Molded	-40000 to -40499
Assembly	-60000 to -60499
Component	-80000 to -80299
Documentation	-90000 to -90249

Table 6-1. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	05045-60001	6	1	BOARD ASSEMBLY, +15V/18V REGULATOR (SERIES 1852)	28480	05045-60001
A1C1	0180-0578	9	1	CAPACITOR-FXD 750UF+75-10% 40VDC AL	56289	39D757G040CL4
A1C2	0150-0121	5	11	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A1C3	0180-1735	2	4	CAPACITOR-FXD .22UF+-10% 35VDC TA	56289	150D224X9035A2
A1C4	0180-0117	2	2	CAPACITOR-FXD 2.7UF+-10% 35VDC TA	56289	150D275X9035B2
A1C5	0180-0117	2		CAPACITOR-FXD 2.7UF+-10% 35VDC TA	56289	150D275X9035B2
A1C6	0160-0127	2	29	CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A1C7	0180-1735	2		CAPACITOR-FXD .22UF+-10% 35VDC TA	56289	150D224X9035A2
A1C8	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A1C9	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A1CR1	1901-0638	3	3	DIODE-FW BRDG 100V 4A	04713	MDA-970-2
A1CR2	1901-0638	3		DIODE-FW BRDG 100V 4A	04713	MDA-970-2
A1R1	0698-0083	8	1	RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1961-F
A1R2	2100-1757	2	2	RESISTOR-TRMR 500 5% ww SIDE-ADJ 1-TRN	28480	2100-1757
A1TP1	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
A1TP2	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
A1TP3	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
A1TP4	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
A1U1	1826-0233	4	1	IC V RGLTR TO-3	27014	LM220K-15
A1U2	1826-0126	4	1	IC 7818 V RGLTR TO-3	04713	MC7818CK
A1U3	1826-0169	5	1	IC V RGLTR TO-3	27014	LM320K-15
A1U4	1826-0203	8	1	IC 7815 V RGLTR TO-3	07263	7815KC
	0340-0596	1	12	INSULATOR-XSTR SIL-RBR	28480	0340-0596
	1205-0291	8	5	HEAT SINK TO-3-PKG	28480	1205-0291
	1480-0116	8	26	PIN-GRV .062-IN-DIA .25-IN-LG STL	28480	1480-0116
	4040-0749	4	4	EXTR-PC BD BRN POLYC .062-RD-THKNS	28480	4040-0749
A2	05045-60002	7	1	BOARD ASSEMBLY, 7.5/12V REGULATOR (SERIES 1852)	28480	05045-60002
A2C1	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A2C2	0180-0197	8	5	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2C3	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2C4	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A2C5	0180-1735	2		CAPACITOR-FXD .22UF+-10% 35VDC TA	56289	150D224X9035A2
A2C6	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A2C7	0180-1735	2		CAPACITOR-FXD .22UF+-10% 35VDC TA	56289	150D224X9035A2
A2C8	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A2CR1	1901-0638	3		DIODE-FW BRDG 100V 4A	04713	MDA-970-2
A2R1	0757-0284	7	1	RESISTOR 150 1% .125W F TC=0+-100	24546	C4-1/8-TO-151-F
A2R2	2100-1755	0	2	RESISTOR-TRMR 100 5% WW SIDE-ADJ 1-TRN	28480	2100-1755
A2R3	2100-1755	0		RESISTOR-TRMR 100 5% WW SIDE-ADJ 1-TRN	28480	2100-1755
A2R4	0698-3443	0	1	RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-TO-287R-F
A2TP1	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
A2TP2	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
A2TP3	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
A2TP4	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
A2U1	1826-0160	6	1	IC V RGLTR TO-3	07263	7806KC
A2U2	1826-0235	6	1	IC V RGLTR TO-3	27014	LM220K-12
A2U3	1826-0117	3	1	IC 7812 V RGLTR TO-3	07263	7812KC
A2U4	1826-0202	7	2	IC V RGLTR TO-3	27014	LM320K-05
	0340-0596	1		INSULATOR-XSTR SIL-RBR	28480	0340-0596
	1205-0290	7	1	HEAT SINK TO-3-PKG	28480	1205-0290
	1205-0291	8		HEAT SINK TO-3-PKG	28480	1205-0291
	1480-0116	8		PIN-GRV .062-IN-DIA .25-IN-LG STL	28480	1480-0116
	4040-0750	7	5	EXTR-PC 80 RED POLYC .062-RD-THKNS	28480	4040-0750
	1205-0381	7	1	HEAT SINK SGL TO-3-CS	3M161	5926
A3	05045-60003	8	2	BOARD ASSEMBLY, +5/18V REGULATOR (SERIES 1520)	28480	05045-60003
A3C1	0160-3456	6	23	CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A3C2	0160-3879	7	3	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C3	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A3C4	0180-0155	8	1	CAPACITOR-FXD 2.2UF+-20% 20VDC TA	56289	150D225X9020A2
A3C5	0160-0574	3	1	CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
A3C6	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A3C7	0180-0116	1	4	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3C8	0180-1912	7	1	CAPACITOR-FXD 12000UF+75-10% 8VDC AL	56289	39D128G008FJ4

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-1. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3CR1	1901-0033	2	1	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3CR2	1902-3036	3	2	DIODE-ZNR 3.16V 5% DO-7 PD=.4W TC=-.064%	28480	1902-3036
A3CR3	1902-3036	3		DIODE-ZNR 3.16V 5% DO-7 PD=.4W TC=-.064%	28480	1902-3036
A3CR4	1902-0079	8	1	DIODE-ZNR 20V 2% DO-14 PD=.4W TC=+.08%	28480	1902-0079
A3CR5	1901-0040	1	91	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3Q1	1884-0217	6	1	THYRISTOR-TRIAC	04713	MAC-10-4
A3Q2	1854-0671	3	3	TRANSISTOR NPN 2N6282 SI TO-3 PD=160W	04713	2N6282
A3R1	0757-0921	9	2	RESISTOR 750 2% .125W F TC=0+-100	24546	C4-1/8-T0-751-G
A3R2	0757-0948	0	16	RESISTOR 10K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
A3R3	0757-0932	2	2	RESISTOR 2.2K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2201-G
A3R4	0757-0948	0		RESISTOR 10K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
A3R5	0757-0900	4	16	RESISTOR 100 2% .125W F TC=0+-100	24546	C4-1/8-T0-101-G
A3R6	0757-0916	2	2	RESISTOR 470 2% .125W F TC=0+-100	24546	C4-1/8-T0-471-G
A3R7	0757-0916	2		RESISTOR 470 2% .125W F TC=0+-100	24546	C4-1/8-T0-471-G
A3R8	0811-3333	9	2	RESISTOR .05 3% 2W PWW TC=0+-150	28480	0811-3333
A3R9	0757-0961	7	1	RESISTOR 36K 2% .125W F TC=0+-100	24546	C4-1/8-T0-3602-G
A3R10	0811-3332	8	1	RESISTOR .025 1% 5W PW TC=0+-150	28480	0811-3332
A3R11	0686-1005	1	1	RESISTOR 10 5% .5W CC TC=0+412	01121	EB1005
A3R12	0811-3333	9		RESISTOR .05 3% 2W PWW TC=0+-150	28480	0811-3333
A3R13	2100-1757	2		RESISTOR-TRMR 500 5% WW SIDE-ADJ 1-TRN	28480	2100-1757
A3R14	0757-0913	9	1	RESISTOR 360 2% .125W F TC=0+-100	24546	C4-1/8-T0-361-G
A3TP1	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
A3TP2	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
A3TP3	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
A3TP4	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
A3U1	1820-0039	0	1	IC V RGLTR 14-DIP-P	07263	723PC
A3U2	1820-0216	1	1	OP AMP GP 8-DIP-P	28480	1820-0216
A3U3	1826-0202	7		IC V RGLTR TO-3	27014	LM320K-05
	0340-0596	1		INSULATOR-XSTR SIL-RBR	28480	0340-0596
	1205-0286	7	1	HEAT SINK SGL TO-3-PKG	28480	1205-0286
	1205-0291	8		HEAT SINK TO-3-PKG	28480	1205-0291
	1480-0116	8		PIN-GRV .062-IN-DIA .25-IN-LG STL	28480	1480-0116
	4040-0751	8	4	EXTR-PC BD ORN POLYC .062-BD-THKNS	28480	4040-0751
A4	05045-60004	9	1	BOARD ASSEMBLY, ARITHMETIC LOG (SERIES 1520)	28480	05045-60004
A4C1	0180-0210	6	10	CAPACITOR-FXD 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
A4R1	0757-0941	3	30	RESISTOR 5.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5101-G
A4R2	0757-0941	3		RESISTOR 5.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5101-G
A4R3	0757-0941	3		RESISTOR 5.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5101-G
A4U1	1820-0077	2	18	IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN7474N
A4U2	1820-0368	4	8	IC SHF-RGTR TTL R-S PRL-IN PRL-OUT 5-BIT	01295	SN7496N
A4U3	1820-0368	4		IC SHF-RGTR TTL R-S PRL-IN PRL-OUT 5-BIT	01295	SN7496N
A4U4	1820-0368	4		IC SHF-RGTR TTL R-S PRL-IN PRL-OUT 5-BIT	01295	SN7496N
A4U5	1820-0328	6	8	IC GATE TTL NOR QUAD 2-INP	01295	SN7402N
A4U6	1820-0545	9	1	IC CNTR TTL BIN UP/DOWN SYNCHRO	01295	SN74191N
A4U7	1820-0629	0	2	IC FF TTL S J-K NEG-EDGE-TRIG	01295	SN74S112N
A4U8	1820-0606	3	1	IC ARITH-LGC-UN TTL 4-BIT	01295	SN74181N
A4U9	1820-0077	2		IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN7474N
A4U10	1820-0782	6	3	IC GATE TTL NOR TPL 3-INP	01295	SN7427N
A4U11	1820-0301	5	1	IC LCH TTL D-TYPE 4-BIT	01295	SN7475N
A4U12	1820-0616	5	5	IC MUXR/DATA-SEL TTL 2-TO-1-LINE QUAD	07263	9322PC
A4U13	1820-0174	0	2	IC INV TTL HEX	01295	SN7404N
A4U14	1820-0068	1	2	IC GATE TTL NAND TPL 3-INP	01295	SN7410N
A4U15	1820-0640	5	1	IC MUXR/DATA-SEL TTL 16-TO-1-LINE 16-INP	01295	SN74150N
A4U16	1820-0054	5	7	IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A4U17	1820-0281	0	2	IC FF TTL J-K M/S PULSE CLEAR DUAL	01295	SN74107N
A4U18	1820-0683	6	6	IC INV TTL S HEX 1-INP	01295	SN74S04N
A4U19	1820-0262	7	1	IC SHF-RGTR TTL R-S PRL-IN SERIAL-OUT	27014	DM8590N
A4U20	1820-0782	6		IC GATE TTL NOR TPL 3-INP	01295	SN7427N
A4U21	1820-0620	1	1	IC MUXR/DATA-SEL TTL 4-TO-1-LINE DUAL	01295	SN74153N
A4U22	1820-0214	9	2	IC DCDR TTL BCD-TO-DEC 4-TO-10-LINE	01295	SN7442AN
A4U23	1820-0495	8	1	IC DCDR TTL 4-TO-16-LINE 4-INP	01295	SN74154N
	1480-0116	8		PIN-GRV .062-IN-DIA .25-IN-LG STL	28480	1480-0116
	4040-0748	3	2	EXTR-PC BD BLK POLYC .062-BD-THKNS	28480	4040-0748
A5	05045-60005	0	1	BOARD ASSEMBLY, PROCESSOR MEMORY (SERIES 1520)	28480	05045-60005
A5R1	0757-0917	3	18	RESISTOR 510 2% .125W F TC=0+-100	24546	C4-1/8-T0-511-G
A5TP1	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
A5TP2	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-1. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A5U1	1820-0716	6	21	IC CNTR TTL 8IN SYNCHRO POS-EDGE-TRIG	01295	SN74161N
A5U2	1820-0373	1	1	IC GATE TTL H NAND DUAL 4-INP	01295	SN74H20N
A5U3	1820-0686	9	1	IC GATE TTL S AND TPL 3-INP	01295	SN74S11N
A5U4	1820-0694	9	1	IC GATE TTL S EXCL-OR QUAD 2-INP	01295	SN74S86N
A5U5	1820-0380	0	2	IC GATE TTL H AND-OR-INV	01295	SN74H53N
A5U6	1820-0693	8	8	IC FF TTL S D-TYPE POS-EDGE-TRIG	01295	SN74S74N
A5U7	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A5U8	1820-0328	6		IC GATE TTL NOR QUAD 2-INP	01295	SN7402N
A5U9	1820-0716	6		IC CNTR TTL 8IN SYNCHRO POS-EDGE-TRIG	01295	SN74161N
A5U10	1816-0598	3	2	IC TTL 256-BIT RAM 3-S	01295	SN74S200N
A5U11	1816-0598	3		IC TTL 256-BIT RAM 3-S	01295	SN74S200N
A5U12	1820-0716	6		IC CNTR TTL 8IN SYNCHRO POS-EDGE-TRIG	01295	SN74161N
A5U13	1820-0685	8	5	IC GATE TTL S NAND TPL 3-INP	01295	SN74S10N
A5U14	1820-1107	1	1	IC SHF-RGTR TTL R-S PRL-IN SERIAL-OUT	01295	SN74166N
A5U15	1820-0716	6		IC CNTR TTL 8IN SYNCHRO POS-EDGE-TRIG	01295	SN74161N
A5U16	1820-0716	6		IC CNTR TTL 8IN SYNCHRO POS-EDGE-TRIG	01295	SN74161N
A5U17	1820-0083	6		IC INV TTL S HEX 1-INP	01295	SN74S04N
A5U18	1820-0716	6		IC CNTR TTL 8IN SYNCHRO POS-EDGE-TRIG	01295	SN74161N
A5U19	1820-0716	6		IC CNTR TTL 8IN SYNCHRO POS-EDGE-TRIG	01295	SN74161N
A5U20	1820-0822	3	1	IC MUXR/DATA-SEL TTL 8-TO-1-LINE 8-INP	01295	SN74151AN
	1480-0116	8		PIN-GRV .062-IN-DIA .25-IN-LG STL	28480	1480-0116
	4040-0749	4		EXTR-PC BD BRN POLYC .062-BD-THKNS	28480	4040-0749
A6	05045-60006	1	1	BOARD ASSEMBLY, MAIN MEMORY (SERIES 1712)	28480	05045-60006
A6C1	0160-0301	4	1	CAPACITOR-FXD .012UF +-10% 200VDC POLYE	28480	0160-0301
A6C2	0180-0210	6		CAPACITOR-FXD 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
A6C3	0180-0210	6		CAPACITOR-FXD 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
A6C4	0180-0210	6		CAPACITOR-FXD 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
A6C5	0160-3060	8	1	CAPACITOR-FXD .1UF +-20% 25VDC CER	28480	0160-3060
A6C6	0180-0210	6		CAPACITOR-FXD 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
A6C7	0180-0210	6		CAPACITOR-FXD 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
A6C8	0160-0165	8	2	CAPACITOR-FXD .056UF +-10% 200VDC POLYE	28480	0160-0165
A6C9	0160-0165	8		CAPACITOR-FXD .056UF +-10% 200VDC POLYE	28480	0160-0165
A6C10	0180-1746	5	8	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A6C11	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A6C12	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A6R1	0757-0941	3		RESISTOR 5.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5101-G
A6R2	0757-0965	1	20	RESISTOR 51K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5102-G
A6R3	0757-0941	3		RESISTOR 5.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5101-G
A6R4				NOT ASSIGNED		
A6R5				NOT ASSIGNED		
A6R6	0757-0941	3		RESISTOR 5.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5101-G
A6R9	1810-0041	9	10	NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0041
A6R10	1810-0041	9		NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0041
A6R11	1810-0041	9		NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0041
A6R12	1810-0041	9		NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0041
A6R13	1810-0041	9		NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0041
A6R14	1810-0041	9		NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0041
A6R15	0698-3150	6	2	RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A6R16	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A6R17	0698-8823	0	2	RESISTOR 8.25 1% .125W F TC=0+-100	28480	0698-8823
A6R18	0698-8823	0		RESISTOR 8.25 1% .125W F TC=0+-100	28480	0698-8823
A6U1	1820-0716	6		IC CNTR TTL 8IN SYNCHRO POS-EDGE-TRIG	01295	SN74161N
A6U2	1820-0716	6		IC CNTR TTL 8IN SYNCHRO POS-EDGE-TRIG	01295	SN74161N
A6U3	1820-0281	0		IC FF TTL J-K M/S PULSE CLEAR DUAL	01295	SN74107N
A6U4	1820-0681	4	5	IC GATE TTL S NAND QUAD 2-INP	01295	SN74S00N
A6U5	1820-0693	8		IC FF TTL S D-TYPE POS-EDGE-TRIG	01295	SN74S74N
A6U6	1820-1288	9	1	IC DRVR TTL CLOCK DRVR TTL-TO-MOS 1-INP	04713	MMH0026CL
A6U7	1820-0733	7	8	IC SHF-RGTR PMOS SERIAL-IN SERIAL-OUT	27014	MM1402AD
A6U8	1820-0367	3	12	IC SHF-RGTR TTL R-S PRL-IN PRL-OUT 4-BIT	01295	SN7495AN
A6U9	1820-0733	7		IC SHF-RGTR PMOS SERIAL-IN SERIAL-OUT	27014	MM1402AD
A6U10	1820-0367	3		IC SHF-RGTR TTL R-S PRL-IN PRL-OUT 4-BIT	01295	SN7495AN
A6U11	1820-0328	0		IC GATE TTL NOR QUAD 2-INP	01295	SN7402N
A6U12	1820-0207	0	1	IC MV TTL MONOSTBL RETRIG/RESET	04713	MC8601P
A6U13	1820-0693	8		IC FF TTL S D-TYPE POS-EDGE-TRIG	01295	SN74S74N
A6U14	1820-0685	8		IC GATE TTL S NAND TPL 3-INP	01295	SN74S10N
A6U15	1820-0693	8		IC FF TTL S D-TYPE POS-EDGE-TRIG	01295	SN74S74N
A6U16	1820-0733	7		IC SHF-RGTR PMOS SERIAL-IN SERIAL-OUT	27014	MM1402AD
A6U17	1820-0367	3		IC SHF-RGTR TTL R-S PRL-IN PRL-OUT 4-BIT	01295	SN7495AN
A6U18	1820-0733	7		IC SHF-RGTR PMOS SERIAL-IN SERIAL-OUT	27014	MM1402AD
A6U19	1820-0367	3		IC SHF-RGTR TTL R-S PRL-IN PRL-OUT 4-BIT	01295	SN7495AN
A6U20	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-1. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A6U21	1820-0685	8		IC GATE TTL S NAND TPL 3-INP	01295	SN74S10N
A6U22	1820-0683	6	1	IC INV TTL S HEX 1-INP	01295	SN74S04N
A6U23	1820-1449	4		IC GATE TTL S OR QUAD 2-INP	01295	SN74S32N
A6U24	1820-0693	8		IC FF TTL S D-TYPE POS-EDGE-TRIG	01295	SN74S74N
A6U25	1820-0733	7		IC SHF-RGTR PMOS SERIAL-IN SERIAL-OUT	27014	MM1402AD
A6U26	1820-0387	3		IC SHF-RGTR TTL P-S PRL-IN PRL-OUT 4-BIT	01295	SN7495AN
A6U27	1820-1195	7	2	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A6U28	1820-0077	2		IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN7474N
A6U29	1820-0512	0	1	IC FF TTL H D-TYPE POS-EDGE-TRIG	01295	SN74H74N
A6U30	1820-0681	4		IC GATE TTL S NAND QUAD 2-INP	01295	SN74S00N
A6U31	1820-1158	2	1	IC GATE TTL S AND-OR-INV DUAL 2-INP	01295	SN74S51N
A6U32	1820-0616	5		IC MUXR/DATA-SEL TTL 2-TO-1-LINE QUAD	07263	9322PC
A6U33	1820-0616	5		IC MUXR/DATA-SEL TTL 2-TO-1-LINE QUAD	07263	9322PC
A6U34	1820-0616	5		IC MUXR/DATA-SEL TTL 2-TO-1-LINE QUAD	07263	9322PC
A6U35	1820-0733	7		IC SHF-RGTR PMOS SERIAL-IN SERIAL-OUT	27014	MM1402AD
A6U36	1820-0367	3		IC SHF-RGTR TTL P-S PRL-IN PRL-OUT 4-BIT	01295	SN7495AN
A6U37	1820-0629	0		IC FF TTL S J-K NEG-EDGE-TRIG	01295	SN74S112N
A6U38	1820-0681	4	4	IC GATE TTL S NAND QUAD 2-INP	01295	SN74S00N
A6U39	1820-0511	9		IC GATE TTL AND QUAD 2-INP	01295	SN7408N
	1480-0116	8		PIN-GRV .062-IN-DIA .25-IN-LG STL	28480	1480-0116
	0340-0750	7		EXTR-PC BD RED POLYC .062-BD-THKNS	28480	0340-0750
A7	05045-60007	2	1	BOARD ASSEMBLY, I/O HPIB (SERIES 1852)	28480	05045-60007
A7C1	0160-0571	0		CAPACITOR-FXD 470PF +-20% 100VDC CER	28480	0160-0571
A7C2	0160-0571	0	4	CAPACITOR-FXD 470PF +-20% 100VDC CER	28480	0160-0571
A7C3	0160-0571	0		CAPACITOR-FXD 470PF +-20% 100VDC CER	28480	0160-0571
A7C4	0160-0571	0		CAPACITOR-FXD 470PF +-20% 100VDC CER	28480	0160-0571
A7J1	1200-0522	8	1	SOCKET-IC 24-CONT DIP-SLDR	28480	1200-0522
A7R1	1810-0030	6	6	NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0030
A7R2	1810-0030	6		NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0030
A7R3	0757-0407	6	4	RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A7R4	0757-0407	6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A7R5	0757-0407	6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A7R6	0757-0407	6	17	RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A7R7	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A7S1	3101-1860	1	2	SWITCH-SL 5-1A DIP-SLIDE-ASSY .1A 50VDC	28480	3101-1860
A7U1	1820-0706	4	1	IC COMPTR TTL MAGTD 5-BIT	07263	9324PC
A7U2	1820-1112	8	4	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
A7U3	1820-1116	2	1	IC FF TTL J-K BAR POS-EDGE-TRIG	01295	SN74109N
A7U4	1820-1202	7	2	IC GATE TTL LS NAND TPL 3-INP	01295	SN74LS10N
A7U5	1820-1282	3	4	IC FF TTL LS J-K BAR POS-EDGE-TRIG	01295	SN74LS109AN
A7U6	1820-1282	3		IC FF TTL LS J-K BAR POS-EDGE-TRIG	01295	SN74LS109AN
A7U7	1820-1282	3		IC FF TTL LS J-K BAR POS-EDGE-TRIG	01295	SN74LS109AN
A7U8	1820-0685	8		IC GATE TTL S NAND TPL 3-INP	01295	SN74S10N
A7U9	1820-0367	3		IC SHF-RGTR TTL P-S PRL-IN PRL-OUT 4-BIT	01295	SN7495AN
A7U10	1820-1053	6	2	IC SCHMITT-TRIG TTL INV HEX	01295	SN7414N
A7U11	1820-1216	3	2	IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A7U12	1820-1281	2	1	IC DCDR TTL LS 2-TO-4-LINE DUAL 2-INP	01295	SN74LS139N
A7U13	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A7U14	1820-1195	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A7U15	1820-0683	6		IC INV TTL S HEX 1-INP	01295	SN74S04N
A7U16	1820-1211	8	1	IC GATE TTL LS EXCL-OR QUAD 2-INP	01295	SN74LS86N
A7U17	1820-0628	9	8	IC TTL 64-BIT RAM 50-NS 0-C	01295	SN7486N
A7U18	1820-0681	4		IC GATE TTL S NAND QUAD 2-INP	01295	SN74S00N
A7U19	1820-0716	6		IC CNTR TTL BIN SYNCHRO POS-EDGE-TRIG	01295	SN74161N
A7U20	1820-0628	9		IC TTL 64-BIT RAM 50-NS 0-C	01295	SN7489N
A7U21	1820-1199	1	1	IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A7U22	1820-1053	6		IC SCHMITT-TRIG TTL INV HEX	01295	SN7414N
A7U23	1820-1322	2	3	IC GATE TTL S NOR QUAD 2-INP	01295	SN74S02N
A7U24	1820-1208	3	1	IC GATE TTL LS OR QUAD 2-INP	01295	SN74LS32N
A7U25	1820-1283	4	2	IC SHF-RGTR TTL LS P-S PRL-IN PRL-OUT	01295	SN74LS95BN
A7U26	1820-1202	7		IC GATE TTL LS NAND TPL 3-INP	01295	SN74LS10N
A7U27	1820-1322	2		IC GATE TTL S NOR QUAD 2-INP	01295	SN74S02N
A7U28	1820-1283	4		IC SHF-RGTR TTL LS P-S PRL-IN PRL-OUT	01295	SN74LS95BN
A7U29	1820-0628	9		IC TTL 64-BIT RAM 50-NS 0-C	01295	SN7489N
A7U30	1820-0621	2	4	IC BFR TTL NAND QUAD 2-INP	01295	SN7438N
A7U31	1820-0621	2		IC BFR TTL NAND QUAD 2-INP	01295	SN7438N
A7U32	1820-1282	3		IC FF TTL LS J-K BAR POS-EDGE-TRIG	01295	SN74LS109AN
A7U33	1820-0328	6		IC GATE TTL NOR QUAD 2-INP	01295	SN7402N
A7U34	1820-0621	2		IC BFR TTL NAND QUAD 2-INP	01295	SN7438N
A7U35	1820-0621	2		IC BFR TTL NAND QUAD 2-INP	01295	SN7438N

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-1. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A7U36	1820-1201	6	1	IC GATE TTL LS AND QUAD 2-INP	01295	SN74LS08N
A7U37	1820-1433	6	2	IC SHF-RGTR TTL LS R-S SERIAL-IN PRL-OUT	01295	SN74LS164N
A7U38	1820-0081	4		IC GATE TTL S NAND QUAD 2-INP	01295	SN74S00N
A7U39	1820-1470	1	1	IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE QUAD	01295	SN74LS157N
A7U40	1820-1194	6	1	IC CNTR TTL LS BIN UP/DOWN SYNCHRO	01295	SN74LS193N
A7U41	1820-0692	7	1	IC GATE TTL S AND-OR-INV	01295	SN74S65N
A7U42	1820-1207	2	1	IC GATE TTL LS NAND 8-INP	01295	SN74LS30N
A7U43	1820-0628	9		IC TTL 64-BIT RAM 60-NS 0-C	01295	SN7489N
	0360-1682	0	37	TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
	4040-0751	8		EXTR-PC BD ORN POLYC .062-BD-THKNS	28480	4040-0751
	1200-0521	7	1	LOCK-DUAL INLINE PKG INLINE PKG	52072	CA-24-200-DL
A8	05045-60008	3	1	BOARD ASSEMBLY, ROM (SERIES 1520)	28480	05045-60008
A8R1	0757-0941	3		RESISTOR 5.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5101-G
A8R2	0757-0924	2	33	RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A8R3	1810-0030	6		NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0030
A8R4	1810-0030	6		NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0030
A8R5	0757-0907	1	5	RESISTOR 200 2% .125W F TC=0+-100	24546	C4-1/8-T0-201-G
A8U1	1818-2278	4	1	IC,MOS ROM 512 X 8	28480	1818-2278
A8U2	1818-2281	9	1	IC,MOS ROM 512 X 8	28480	1818-2281
A8U3	1818-2284	2	1	IC,MOS ROM 512 X 8	28480	1818-2284
A8U4	1820-1294	7	3	IC MUXR/DATA-SEL TTL 2-TO-1-LINE QUAD	27014	DM8123N
A8U5	1820-0661	0	3	IC GATE TTL OR QUAD 2-INP	01295	SN7432N
A8U6	1818-2277	3	1	IC,MOS ROM 512 X 8	28480	1818-2277
A8U7	1818-2280	8	1	IC,MOS ROM 512 X 8	28480	1818-2280
A8U8	1818-2283	1	1	IC,MOS ROM 512 X 8	28480	1818-2283
A8U9	1820-1294	7		IC MUXR/DATA-SEL TTL 2-TO-1-LINE QUAD	27014	DM8123N
A8U10	1820-0077	2		IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN7474N
A8U11	1818-2276	2	1	IC,MOS ROM 512 X 8	28480	1818-2276
A8U12	1818-2279	5	1	IC,MOS ROM 512 X 8	28480	1818-2279
A8U13	1818-2282	0	1	IC,MOS ROM 512 X 8	28480	1818-2282
A8U14	1820-1294	7		IC MUXR/DATA-SEL TTL 2-TO-1-LINE QUAD	27014	DM8123N
A8U15	1820-0214	9		IC DCDR TTL BCD-TO-DEC 4-TO-10-LINE	01295	SN7442AN
	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
	1480-0116	8		PIN-GRV .062-IN-DIA .25-IN-LG STL	28480	1480-0116
	4040-0752	9	4	EXTR-PC BD YEL POLYC .062-BD-THKNS	28480	4040-0752
A9	05045-60009	4	1	BOARD ASSEMBLY, ADDRESS (SERIES 1852)	28480	05045-60009
A9C1	0180-0210	6		CAPACITOR-FXD 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
A9C2	0180-0210	6		CAPACITOR-FXD 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
A9C3	0160-2200	6	1	CAPACITOR-FXD 43PF +-5% 300VDC MICA	28480	0160-2200
A9C4	0180-0106	9	1	CAPACITOR-FXD 600UF+-20% 6VDC TA	56289	150D606X0006B2
A9CR1	1902-0126	6	1	DIODE-ZNR 2.61V 5% DO-7 PD=.4W TC=-.072%	28480	1902-0126
A9CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9Q1	1854-0071	7	27	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A9R1	0757-0941	3		RESISTOR 5.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5101-G
A9R2	0757-0941	3		RESISTOR 5.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5101-G
A9R3	0757-0941	3		RESISTOR 5.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5101-G
A9R4	2100-2633	5	3	RESISTOR-TRMR 1K 10% C SIDE-ADJ 1-TRN	30983	ET50X102
A9R5	0757-0279	0	1	RESISTOR 3.16K 1% .125W F TC=0+-100 .	24546	C4-1/8-T0-3161-F
A9R6	0757-0940	2	4	RESISTOR 4.7K 2% .125W F TC=0+-100	24546	C4-1/8-T0-4701-G
A9R7	0757-0940	2		RESISTOR 4.7K 2% .125W F TC=0+-100	24546	C4-1/8-T0-4701-G
A9R8	0757-0924	2		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A9R9	0757-0976	4	7	RESISTOR 150K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1503-G
A9R10	0757-0948	0		RESISTOR 10K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
A9R11	1810-0164	7	1	NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0164
A9R12	0757-0940	2		RESISTOR 4.7K 2% .125W F TC=0+-100	24546	C4-1/8-T0-4701-G
A9R13	0757-0972	0	15	RESISTOR 100K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1003-G
A9R14	0757-0924	2		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A9TP1	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
A9TP2	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
A9TP3	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
A9TP4	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
A9TP5	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
A9TP6	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
A9U1	1820-0511	9		IC GATE TTL AND QUAD 2-INP	01295	SN7408N
A9U2	1820-0661	0		IC GATE TTL OR QUAD 2-INP	01295	SN7432N
A9U3	1820-0697	2	1	IC DRVR TTL S NAND LINE DUAL 4-INP	01295	SN74S140N
A9U4	1820-0068	1		IC GATE TTL NAND TPL 3-INP	01295	SN7410N
A9U5	1820-0567	5	1	IC MV TTL DUAL	04713	MC4024P

Table 6-1. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A9U6	1820-0655	2	1	IC GATE TTL NOR DUAL 4-INP	01295	SN7425N
A9U7	1820-0069	2	1	IC GATE TTL NAND QUAD 4-INP	01295	SN7420N
A9U8	1820-0077	2		IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN7474N
A9U9	1820-0077	2		IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN74S04N
A9U10	1820-0683	6		IC INV TTL S HEX 1-INP	01295	SN74H53N
				IC GATE TTL H AND-OR-INV	01295	SN74161N
A9U11	1820-0380	0		IC CNTR TTL BIN SYNCHRO POS-EDGE-TRIG	01295	SN74164N
A9U12	1820-0716	6		IC SHF-RGTR TTL SERIAL-IN PRL-OUT 8-BIT	01295	SN7408N
A9U13	1820-1064	9	1	IC INV TTL HEX 1-INP	01295	SN74S74N
A9U14	1820-0471	0	10	IC FF TTL S D-TYPE POS-EDGE-TRIG		
A9U15	1820-0693	8			01295	SN7474N
				IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN74161N
A9U16	1820-0077	2		IC CNTR TTL BIN SYNCHRO POS-EDGE-TRIG	01295	SN74174N
A9U17	1820-0716	6		IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR HEX	01295	SN74161N
A9U18	1820-0788	2	5	IC CNTR TTL 8IN SYNCHRO POS-EDGE-TRIG	01295	SN74161N
A9U19	1820-0716	6		IC CNTR TTL 8IN SYNCHRO POS-EDGE-TRIG		
A9U20	1820-0716	6			01295	SN74165N
				IC SHF-RGTR TTL R-S PRL-IN SERIAL-OUT		
A9U21	1820-1042	3	2		28480	1480-0116
				PIN-GRV .062-IN-DIA .25-IN-LG STL	28480	4040-0753
	1480-0116	8		EXTR-PC 8D GRN POLYC .062-BD-THKNS		
	4040-0753	0	2			
					28480	05045-60010
	05045-60010	7	1	BOARD ASSEMBLY, DAC		
A10				(SERIES 1520)		
					28480	0160-2055
	0160-2055	9	15	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A10C1	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3456
A10C2	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	00908	T110B335K035AS
A10C3	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER		
A10C4	0160-0161	6	11	CAPACITOR-FXD 3.3UF+-10% 35VDC TA	28480	0160-2055
A10C5					00908	T110B335K035AS
	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A10C6	0160-0161	6		CAPACITOR-FXD 3.3UF+-10% 35VDC TA	00908	T110B335K035AS
A10C7	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER		
A10C8	0160-0161	6		CAPACITOR-FXD 3.3UF+-10% 35VDC TA		
A10C9					28480	1902-3234
	1902-3234	3	2	DIODE-ZNR 19.6V 5% DO-7 PD=.4W TC=+.073%	28480	1901-0040
A10CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A10CR2	1901-0040	1		DIODE-ZNR 7.5V 5% DO-7 PD=.4W TC=+.05%	28480	1902-0064
A10CR3	1902-0064	1	3	DIODE-ZNR 19.6V 5% DO-7 PD=.4W TC=+.073%	28480	1902-3234
A10CR4	1902-3234	3				
A10CR5				DIODE-ZNR 7.5V 5% DO-7 PD=.4W TC=+.05%	28480	1902-0064
	1902-0064	1		DIODE-ZNR 7.5V 5% DO-7 PD=.4W TC=+.05%	28480	1902-0064
A10CR6	1902-0064	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A10CR7	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A10CR8	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35		
A10CR9	1901-0040	1			28480	1901-0040
A10CR10				DIODE-SWITCHING 30V 50MA 2NS DO-35		
	1901-0040	1			28480	1854-0071
A10CR11				TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1853-0020
	1854-0071	7		TRANSISTOR PNP SI PD=300MW FT=150MHZ		
A10Q1	1853-0020	4	26		24546	C4-1/8-T0-1001-G
A10Q2				RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
	0757-0924	2		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-751-G
A10R1	0757-0924	2		RESISTOR 750 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
A10R2	0757-0921	9		RESISTOR 10K 2% .125W F TC=0+-100	24546	C4-1/8-T0-511-G
A10R3	0757-0948	0		RESISTOR 510 2% .125W F TC=0+-100		
A10R4	0757-0917	3			24546	C4-1/8-T0-101-G
A10R5				RESISTOR 100 2% .125W F TC=0+-100	24546	C4-1/8-T0-511-G
	0757-0900	4		RESISTOR 510 2% .125W F TC=0+-100	24546	C4-1/8-T0-511-G
A10R6	0757-0917	3		RESISTOR 510 2% .125W F TC=0+-100	24546	C4-1/8-T0-511-G
A10R7	0757-0917	3		RESISTOR 510 2% .125W F TC=0+-100	24546	C4-1/8-T0-101-G
A10R8	0757-0917	3		RESISTOR 100 2% .125W F TC=0+-100		
A10R9	0757-0900	4			24546	C4-1/8-T0-5101-G
A10R10				RESISTOR 5.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2001-G
	0757-0941	3	7	RESISTOR 2K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A10R11	0757-0931	1		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5101-G
A10R12	0757-0924	2		RESISTOR 5.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A10R13	0757-0941	3		RESISTOR 1K 2% .125W F TC=0+-100		
A10R14	0757-0924	2			24546	C4-1/8-T0-3001-G
A10R15				RESISTOR 3K 2% .125W F TC=0+-100	24546	C4-1/8-T0-3001-G
	0757-0935	5	8	RESISTOR 3K 2% .125W F TC=0+-100	24546	C4-1/8-T0-3001-G
A10R16	0757-0935	5		RESISTOR 3K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1502-G
A10R17	0757-0935	5		RESISTOR 150K 2% .125W F TC=0+-100	24546	C4-1/8-T0-3001-G
A10R18	0757-0976	4		RESISTOR 3K 2% .125W F TC=0+-100		
A10R19	0757-0935	5			24546	C4-1/8-T0-3001-G
A10R20				RESISTOR 5K 2% .125W F TC=0+-100	24546	C4-1/8-T0-3001-G
	0757-0935	5		RESISTOR 3K 2% .125W F TC=0+-100	24546	C4-1/8-T0-3001-G
A10R21	0757-0935	5		RESISTOR 3K 2% .125W F TC=0+-100	24546	C4-1/8-T0-3001-G
A10R22	0757-0935	5		RESISTOR 3K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A10R23	0757-0935	5		RESISTOR 1K 2% .125W F TC=0+-100		
A10R24	0757-0924	2			24546	C4-1/8-T0-1001-G
A10R25				RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-201-G
	0757-0924	2		RESISTOR 200 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A10R26	0757-0907	1		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1502-G
A10R27	0757-0924	2		RESISTOR 150K 2% .125W F TC=0+-100	24546	C4-1/8-T0-301-G
A10R28	0757-0976	4	9	RESISTOR 300 2% .125W F TC=0+-100		
A10R29	0757-0911	7				
A10R30						

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-1. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A10R31	0757-0924	2		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A10R32	0757-0941	3		RESISTOR 5.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5101-G
A10R33	0757-0911	7		RESISTOR 300 2% .125W F TC=0+-100	24546	C4-1/8-T0-301-G
A10R34	0757-0948	0		RESISTOR 10K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
A10R35	0757-0958	2	3	RESISTOR 27K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2702-G
A10R36	0757-0924	2		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A10R37	0757-0948	0		RESISTOR 10K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
A10R38	0757-0967	3	1	RESISTOR 62K 2% .125W F TC=0+-100	24546	C4-1/8-T0-6202-G
A10R39	0757-0924	2		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A10R40	0757-0941	3		RESISTOR 5.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5101-G
A10R41	0757-0972	0		RESISTOR 100K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
A10R43	0757-0948	0		RESISTOR 10K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
A10R44	0757-0958	2		RESISTOR 27K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2702-G
A10R45	0757-0924	2		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A10R46	0757-0924	2		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A10R47	0757-0958	2		RESISTOR 27K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2702-G
A10R48	0757-0948	0		RESISTOR 10K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
A10R49	0757-0924	2		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A10U1	1820-0899	6	1	IC CNTR TTL DECD SYNCHRO POS-EDGE-TRIG	01295	SN74160N
A10U2	1820-0716	6		IC CNTR TTL BIN SYNCHRO POS-EDGE-TRIG	01295	SN74161N
A10U3	1820-0716	6		IC CNTR TTL BIN SYNCHRO POS-EDGE-TRIG	01295	SN74161N
A10U4	1820-0716	6		IC CNTR TTL BIN SYNCHRO POS-EDGE-TRIG	01295	SN74161N
A10U5	1820-0511	9		IC GATE TTL AND QUAD 2-INP	01295	SN7408N
A10U6	1820-0733	7		IC SHF-RGTR PMOS SERIAL-IN SERIAL-OUT	27014	MM1402AD
A10U7	1820-0693	8		IC FF TTL S D-TYPE POS-EDGE-TRIG	01295	SN74S74N
A10U8	1820-0077	2		IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN7474N
A10U9	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A10U10	1820-0077	2		IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN7474N
A10U11	1820-0491	4	1	IC DCDR TTL BCD-TO-DEC 4-TO-10-LINE	01295	SN74145N
A10U12	1820-0733	7		IC SHF-RGTR PMOS SERIAL-IN SERIAL-OUT	27014	MM1402AD
A10U13	1820-0471	0		IC INV TTL HEX 1-INP	01295	SN7406N
A10U14	1820-1322	2		IC GATE TTL S NOR QUAD 2-INP	01295	SN74S02N
A10U15	1820-0328	6		IC GATE TTL NOR QUAD 2-INP	01295	SN7402N
A10U16	1820-0077	2		IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN7474N
A10U17	1820-0716	6		IC CNTR TTL BIN SYNCHRO POS-EDGE-TRIG	01295	SN74161N
A10U18	1820-0367	3		IC SHF-RGTR TTL P-S PRL-IN PRL-OUT 4-BIT	01295	SN7495AN
A10U19	1820-0788	2		IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR HEX	01295	SN74174N
A10U20	1820-0471	0		IC INV TTL HEX 1-INP	01295	SN7406N
A10U21	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A10U22	1820-0328	6		IC GATE TTL NOR QUAD 2-INP	01295	SN7402N
A10U23	1820-0377	5	1	IC GATE TTL M AND-OR-INV DUAL 2-INP	01295	SN74H50N
A10U24	1820-0788	2		IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR HEX	01295	SN74174N
A10U25	1820-0471	0		IC INV TTL HEX 1-INP	01295	SN7406N
	1480-0116	8		PIN-GRV .062-IN-DIA .25-IN-LG STL	28480	1480-0116
	4040-0754	1	2	EXTR-PC BD ALU POLYC .062-BD-THKNS	28480	4040-0754
A11	05045-60011	8	1	BOARD ASSEMBLY, REFERENCE LEVEL G (SERIES 1852)	28480	05045-60011
A11C1	0160-4279	3	3	CAPACITOR-FXD 470PF +-10% 200VDC POLYP	71590	CPP-471J
A11C2	0160-4279	3		CAPACITOR-FXD 470PF +-10% 200VDC POLYP	71590	CPP-471J
A11C3	0160-4279	3		CAPACITOR-FXD 470PF +-10% 200VDC POLYP	71590	CPP-471J
A11C4	0140-0209	9	2	CAPACITOR-FXD 5PF +-10% 500VDC MICA	72136	DM15C050K0500WV1CM
A11C5	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A11C6	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A11C7	0160-0181	8	3	CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-0181
A11C8	0160-0181	8		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-0181
A11C9	0160-2218	6	2	CAPACITOR-FXD 1000PF +-5% 300VDC MICA	28480	0160-2218
A11C10	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A11C11	0160-2197	0	1	CAPACITOR-FXD 10PF +-5% 500VDC MICA	28480	0160-2197
A11C12	0140-0209	9		CAPACITOR-FXD 5PF +-10% 500VDC MICA	72136	DM15C050K0500WV1CM
A11C13	0160-0181	8		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-0181
A11C14	0140-0184	9	2	CAPACITOR-FXD 8200PF +-1% 100VDC MICA	72136	DM20F822F0100WV1CM
A11C15	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A11C16	0160-2225	5	2	CAPACITOR-FXD 2000PF +-5% 300VDC MICA	28480	0160-2225
A11C17	0140-0184	9		CAPACITOR-FXD 8200PF +-1% 100VDC MICA	72136	DM20F822F0100WV1CM
A11C18	0160-2225	5		CAPACITOR-FXD 2000PF +-5% 300VDC MICA	28480	0160-2225
A11C19	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A11C20	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A11C21	0180-0181	6		CAPACITOR-FXD 3.3UF+-10% 35VDC TA	00908	T1108335K035AS
A11C22	0140-0151	0	2	CAPACITOR-FXD 820PF +-2% 300VDC MICA	72136	DM15F821G0300WV1CM
A11C23	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A11C24	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A11C25	0160-0362	7	2	CAPACITOR-FXD 510PF +-5% 300VDC MICA	28480	0160-0362

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-1. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A11C26	0160-0362	7		CAPACITOR-FXD 510PF +-5% 300VDC MICA	28480	0160-0362
A11C27	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A11C28	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A11C29	0160-2218	6		CAPACITOR-FXD 1000PF +-5% 300VDC MICA	28480	0160-2218
A11C30	0140-0151	0		CAPACITOR-FXD 820PF +-2% 300VDC MICA	72136	DM15F821G03U0WV1CR
A11C31	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A11C32	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A11C33	0160-2240	8	1	CAPACITOR-FXD 2PF +-.25PF 500VDC CER	28480	0160-2240
A11C34	0180-0161	6		CAPACITOR-FXD 3.3UF+-10% 35VDC TA	00908	T110B335K035AS
A11C35	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A11C36	0180-0161	6		CAPACITOR-FXD 3.3UF+-10% 35VDC TA	00908	T110B335K035AS
A11CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A11CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A11CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A11CR4	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A11CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A11CR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A11CR7	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A11CR8	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A11CR9	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A11CR10	1902-0071	0	1	DIODE-ZNR 9V 5% DO-14 PD=.5W TC=+.001%	28480	1902-0071
A11CR11	9140-0144	0	13	COIL-MLD 4.7UH 10% Q=45 .095DX.25LG=NOM	28480	9140-0144
A11L1	9140-0144	0		COIL-MLD 4.7UH 10% Q=45 .095DX.25LG=NOM	28480	9140-0144
A11L2						
A11Q1	1855-0081	1	3	TRANSISTOR J-FET N-CHAN D-MODE SI	01295	2N5245
A11Q2	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A11Q3	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A11Q4	1853-0020	4		TRANSISTOR J-FET N-CHAN D-MODE SI	28480	1853-0020
A11Q5	1855-0081	1			01295	2N5245
A11Q6	1855-0081	1		TRANSISTOR J-FET N-CHAN D-MODE SI	01295	2N5245
A11Q7	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A11Q8	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A11Q9	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A11Q10	1853-0020	4		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A11Q11	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A11Q12	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A11Q13	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A11R1	0757-0900	4		RESISTOR 100 2% .125W F TC=0+-100	24546	C4-1/8-T0-101-G
A11R2	0757-0900	4		RESISTOR 100 2% .125W F TC=0+-100	24546	C4-1/8-T0-101-G
A11R3	0757-0944	6	6	RESISTOR 6.8K 2% .125W F TC=0+-100	24546	C4-1/8-T0-6801-G
A11R4	0757-0900	4		RESISTOR 100 2% .125W F TC=0+-100	24546	C4-1/8-T0-101-G
A11R5	0757-0900	4		RESISTOR 100 2% .125W F TC=0+-100	24546	C4-1/8-T0-101-G
A11R6	0757-0945	7	3	RESISTOR 7.5K 2% .125W F TC=0+-100	24546	C4-1/8-T0-7501-G
A11R7	0757-0948	0		RESISTOR 10K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
A11R8	0757-0944	6		RESISTOR 6.8K 2% .125W F TC=0+-100	24546	C4-1/8-T0-6801-G
A11R9	0757-0941	3		RESISTOR 5.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5101-G
A11R10	0757-0952	6	3	RESISTOR 15K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1502-G
A11R11	0757-0955	9	15	RESISTOR 20K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2002-G
A11R12	0757-0948	0		RESISTOR 10K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
A11R13	0757-0944	6		RESISTOR 6.8K 2% .125W F TC=0+-100	24546	C4-1/8-T0-6801-G
A11R14	0757-0900	4		RESISTOR 100 2% .125W F TC=0+-100	24546	C4-1/8-T0-101-G
A11R15	0757-0941	3		RESISTOR 5.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5101-G
A11R16	0757-0900	4		RESISTOR 100 2% .125W F TC=0+-100	24546	C4-1/8-T0-101-G
A11R17	0757-0900	4		RESISTOR 100 2% .125W F TC=0+-100	24546	C4-1/8-T0-101-G
A11R18	0757-0900	4		RESISTOR 100 2% .125W F TC=0+-100	24546	C4-1/8-T0-101-G
A11R19	0757-0900	4		RESISTOR 100 2% .125W F TC=0+-100	24546	C4-1/8-T0-101-G
A11R20	0757-0900	4		RESISTOR 100 2% .125W F TC=0+-100	24546	C4-1/8-T0-101-G
A11R21	0757-0972	0		RESISTOR 100K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
A11R22	0757-0931	1		RESISTOR 2K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2001-G
A11R23	0757-0952	6		RESISTOR 15K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1502-G
A11R24	0757-0944	6		RESISTOR 6.8K 2% .125W F TC=0+-100	24546	C4-1/8-T0-6801-G
A11R25	0757-0965	1		RESISTOR 51K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5102-G
A11R26	0757-0933	3	2	RESISTOR 2.4K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2401-G
A11R27	0757-0924	2		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A11R28	0698-3252	9	2	RESISTOR 450 1% .125W F TC=0+-50	28480	0698-3252
A11R29	0757-0944	6		RESISTOR 6.8K 2% .125W F TC=0+-100	24546	C4-1/8-T0-6801-G
A11R30	0757-0952	6		RESISTOR 15K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1502-G
A11R31	0757-0955	9		RESISTOR 20K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2002-G
A11R32	0757-0948	0		RESISTOR 10K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
A11R33	0757-0924	2		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A11R34	0757-0900	4		RESISTOR 100 2% .125W F TC=0+-100	24546	C4-1/8-T0-101-G
A11R35	0757-0972	0		RESISTOR 100K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-1. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A11R36	0757-0940	2		RESISTOR 4.7K 2% .125W F TC=0+-100	24546	C4-1/8-T0-4701-G
A11R37	0757-0957	1	4	RESISTOR 24K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2402-G
A11R38	0757-0394	0	2	RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A11R39	0757-0416	7	2	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A11R40	0757-0957	1		RESISTOR 24K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2402-G
A11R41	0757-0911	7		RESISTOR 300 2% .125W F TC=0+-100	24546	C4-1/8-T0-301-G
A11R42	0757-0924	2		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A11R43	0757-0965	1		RESISTOR 51K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5102-G
A11R44	0757-0933	3		RESISTOR 2.0K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2001-G
A11R45	0757-0957	1		RESISTOR 24K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2402-G
A11R46	0698-3252	9		RESISTOR 450 1% .125W F TC=0+-50	28480	0698-3252
A11R47	0757-0957	1		RESISTOR 24K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2402-G
A11R48	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A11R49	0757-0965	1		RESISTOR 51K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5102-G
A11R50	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A11R51	0757-0965	1		RESISTOR 51K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5102-G
A11R52	0757-0965	1		RESISTOR 51K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5102-G
A11R53	0757-0965	1		RESISTOR 51K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5102-G
A11R54	0757-0965	1		RESISTOR 51K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5102-G
A11R55	0757-0965	1		RESISTOR 51K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5102-G
A11R56	0757-0941	3		RESISTOR 5.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5101-G
A11R57	0757-0941	3		RESISTOR 5.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5101-G
A11R58	0757-0941	3		RESISTOR 5.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5101-G
A11R59	0757-0931	1		RESISTOR 2K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2001-G
A11R60	0757-0941	3		RESISTOR 5.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5101-G
A11R61	0757-0941	3		RESISTOR 5.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5101-G
A11R62	0757-0920	8	1	RESISTOR 680 2% .125W F TC=0+-100	24546	C4-1/8-T0-681-G
A11R63	0757-0941	3		RESISTOR 5.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5101-G
A11R64	0757-0911	7		RESISTOR 300 2% .125W F TC=0+-100	24546	C4-1/8-T0-301-G
A11R65	0698-6977	1	2	RESISTOR 30K .1% .125W F TC=0+-25	28480	0698-6977
A11R66	0757-0945	7		RESISTOR 7.5K 2% .125W F TC=0+-100	24546	C4-1/8-T0-7501-G
A11R67	0698-6977	1		RESISTOR 30K .1% .125W F TC=0+-25	28480	0698-6977
A11R68	0757-0945	7		RESISTOR 7.5K 2% .125W F TC=0+-100	24546	C4-1/8-T0-7501-G
A11R69	0698-6360	6	2	RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A11R70	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A11R71	0757-0915	1	4	RESISTOR 430 2% .125W F TC=0+-100	24546	C4-1/8-T0-431-G
A11R72	0757-0915	1		RESISTOR 430 2% .125W F TC=0+-100	24546	C4-1/8-T0-431-G
A11R73	0757-0915	1		RESISTOR 430 2% .125W F TC=0+-100	24546	C4-1/8-T0-431-G
A11R74	0757-0915	1		RESISTOR 430 2% .125W F TC=0+-100	24546	C4-1/8-T0-431-G
A11R75	0757-0907	1		RESISTOR 200 2% .125W F TC=0+-100	24546	C4-1/8-T0-201-G
A11R76	1810-0202	4	1	NETWORK-RESISTOR 12 BIT BIN LADDER NTWK	73138	812-A11-R50K
A11R77	0757-0972	0		RESISTOR 100K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
A11R78	0757-0944	6		RESISTOR 6.8K 2% .125W F TC=0+-100	24546	C4-1/8-T0-6801-G
A11R79	0757-0926	4	1	RESISTOR 1.2K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1201-G
A11R80	2100-2632	4	2	RESISTOR-TRMR 100 10% C SIDE-ADJ 1-TRN	30983	ET50X101
A11R81	2100-2514	1	4	RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	30983	ET50W203
A11R82	2100-2632	4		RESISTOR-TRMR 100 10% C SIDE-ADJ 1-TRN	30983	ET50X101
A11R83	2100-2514	1		RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	30983	ET50W203
A11R84	2100-2514	1		RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	30983	ET50W203
A11R85	2100-2522	1	2	RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	30983	ET50X103
A11R86	2100-2514	1		RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	30983	ET50W203
A11R87	2100-2522	1		RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	30983	ET50X103
A11R88	2100-2633	5		RESISTOR-TRMR 1K 10% C SIDE-ADJ 1-TRN	30983	ET50X102
A11R89	2100-2489	9	1	RESISTOR-TRMR 5K 10% C SIDE-ADJ 1-TRN	30983	ET50X502
A11R90	2100-2633	5		RESISTOR-TRMR 1K 10% C SIDE-ADJ 1-TRN	30983	ET50X102
A11R91	0757-0924	2		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A11TP1	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-PTG	28480	0360-1682
A11U1	1826-0208	3	11	OP AMP GP 8-DIP-P	27014	LM310N
A11U2	1826-0208	3		OP AMP GP 8-DIP-P	27014	LM310N
A11U3	1826-0207	2	3	OP AMP WB 8-DIP-P	27014	LM318N
A11U4	1826-0207	2		OP AMP WB 8-DIP-P	27014	LM318N
A11U5	1826-0207	2		OP AMP WB 8-DIP-P	27014	LM318N
A11U6	1820-0493	6	1	OP AMP GP 8-DIP-P	27014	LM307N
A11U7	1826-0208	3		OP AMP GP 8-DIP-P	27014	LM310N
A11U8	1826-0208	3		OP AMP GP 8-DIP-P	27014	LM310N
A11U9	1820-1938	6	8	IC CMOS QUAD BILATERAL SWITCH	28480	1820-1938
A11U10	1820-1617	8	5	IC CMOS DUAL D F-F POS EDGE CLOCK	04713	MC14013BCP
A11U11	1826-0208	3		OP AMP GP 8-DIP-P	27014	LM310N
A11U12	1826-0208	3		OP AMP GP 8-DIP-P	27014	LM310N
A11U13	1826-0208	3		OP AMP GP 8-DIP-P	27014	LM310N
A11U14	1826-0208	3		OP AMP GP 8-DIP-P	27014	LM310N
A11U15	1820-1938	6		IC CMOS QUAD BILATERAL SWITCH	28480	1820-1938
A11U16	1820-1617	8		IC CMOS DUAL D F-F POS EDGE CLOCK	04713	MC14013BCP
A11U17	1820-1938	6		IC CMOS QUAD BILATERAL SWITCH	28480	1820-1938
A11U18	1826-0208	3		OP AMP GP 8-DIP-P	27014	LM310N
A11U19	1820-1617	8		IC CMOS DUAL D F-F POS EDGE CLOCK	04713	MC14013BCP
A11U20	1826-0208	3		OP AMP GP 8-DIP-P	27014	LM310N

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-1. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A11U21	1820-1938	6		IC CMOS QUAD BILATERAL SWITCH	28480	1820-1938
A11U22	1820-1617	8	1	IC CMOS DUAL D F-F POS EDGE CLOCK	04713	MC14013BCP
A11U23	1820-0928	2	4	IC BFR CMOS QUAD	01928	CD4041AE
A11U24	1820-1622	5		IC SHF-RGTR CMOS DUAL 4-BIT	28480	1820-1622
A11U25	1820-1622	5		IC SHF-RGTR CMOS DUAL 4-BIT	28480	1820-1622
					27014	LM310N
				OP AMP GP 8-DIP-P	28480	1820-1622
A11U26	1826-0208	3		IC SHF-RGTR CMOS DUAL 4-BIT	01295	SN7406N
A11U27	1820-1622	5		IC INV TTL HEX 1-INP	01928	CD4010AF
A11U28	1820-0471	0	1	IC BFR CMOS HEX 1-INP	28480	1820-1622
A11U29	1820-0980	6		IC SHF-RGTR CMOS DUAL 4-BIT		
A11U30	1820-1622	5			28480	1480-0118
				PIN-GRV .062-IN-DIA .25-IN-LG STL	28480	4040-0755
	1480-0118	8	2	EXTR-PC 80 VIO POLYC .062-BD-THKNS		
	4040-0755	2				
					28480	05045-60012
A12	05045-60012	9	1	BOARD ASSEMBLY, PIN DRIVE C (SERIES 1520)		
					28480	0160-3456
	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A12C1	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A12C2	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A12C3	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A12C4	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER		
A12C5					28480	0160-3456
	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-2055
A12C6	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A12C7	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A12C8	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A12C9	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER		
A12C10					28480	0160-2055
	0160-2055	9	12	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2201
A12C11	0160-2201	7		CAPACITOR-FXD 51PF +-5% 300VDC MICA	28480	0160-2201
A12C12	0160-2201	7		CAPACITOR-FXD 51PF +-5% 300VDC MICA	28480	0160-2201
A12C13	0160-2201	7		CAPACITOR-FXD 51PF +-5% 300VDC MICA	28480	0160-2201
A12C14	0160-2201	7		CAPACITOR-FXD 51PF +-5% 300VDC MICA		
A12C15					28480	0160-2201
	0160-2201	7		CAPACITOR-FXD 51PF +-5% 300VDC MICA	28480	0160-2201
A12C16	0160-2201	7		CAPACITOR-FXD 51PF +-5% 300VDC MICA	28480	0160-2201
A12C17	0160-2201	7		CAPACITOR-FXD 51PF +-5% 300VDC MICA	28480	0160-2201
A12C18	0160-2201	7		CAPACITOR-FXD 51PF +-5% 300VDC MICA	28480	0160-2201
A12C19	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A12C20						
	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A12C21						
	0757-0893	4	7	RESISTOR 51 2% .125W F TC=0+-100	24546	C4-1/8-T0-51R0-G
A12R1	0757-0931	1		RESISTOR 2K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2001-G
A12R2	0757-0931	1		RESISTOR 2K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2001-G
A12R3	0757-0893	4		RESISTOR 51 2% .125W F TC=0+-100	24546	C4-1/8-T0-51R0-G
A12R4	0757-0931	1		RESISTOR 2K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2001-G
A12R5						
	0757-0972	0		RESISTOR 100K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
A12R6	0757-0972	0		RESISTOR 100K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
A12R7	0757-0972	0		RESISTOR 100K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
A12R8	0757-0972	0		RESISTOR 100K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
A12R9	0757-0972	0		RESISTOR 100K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
A12R10						
	0757-0972	0		RESISTOR 100K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
A12R11	1810-0041	9		NETWORK-RES 9-PIN-BIP .15-PIN-SPCG	28480	1810-0041
A12R12	0757-0893	4		RESISTOR 51 2% .125W F TC=0+-100	24546	C4-1/8-T0-51R0-G
A12R13	0757-0893	4		RESISTOR 51 2% .125W F TC=0+-100	24546	C4-1/8-T0-51R0-G
A12R14	0757-0893	4		RESISTOR 51 2% .125W F TC=0+-100	24546	C4-1/8-T0-51R0-G
A12R15						
	0757-0814	9	4	RESISTOR 511 1% .5W F TC=0+-100	28480	0757-0814
A12R16	0757-0972	0		RESISTOR 100K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
A12R17	0757-0814	9		RESISTOR 511 1% .5W F TC=0+-100	28480	0757-0814
A12R18	0757-0972	0		RESISTOR 100K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
A12R19	0757-0900	4		RESISTOR 100 2% .125W F TC=0+-100	24546	C4-1/8-T0-101-G
A12R20						
	0757-0814	9		RESISTOR 511 1% .5W F TC=0+-100	28480	0757-0814
A12R21	0757-0972	0		RESISTOR 100K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
A12R22	0757-0814	9		RESISTOR 511 1% .5W F TC=0+-100	28480	0757-0814
A12R23	0757-0972	0		RESISTOR 100K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
A12R24	0757-0955	9		RESISTOR 20K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2002-G
A12R25						
	0757-0917	3		RESISTOR 510 2% .125W F TC=0+-100	24546	C4-1/8-T0-511-G
A12R26	0757-0955	9		RESISTOR 20K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2002-G
A12R27	0757-0955	9		RESISTOR 20K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2002-G
A12R28	0757-0941	3		RESISTOR 5.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5101-G
A12R29	0757-0941	3		RESISTOR 5.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5101-G
A12R30						
	0757-0955	9		RESISTOR 20K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2002-G
A12R31	0757-0893	4		RESISTOR 51 2% .125W F TC=0+-100	24546	C4-1/8-T0-51R0-G
A12R32	0757-0941	3		RESISTOR 5.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5101-G
A12R33	0757-0941	3		RESISTOR 5.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5101-G
A12R34	0757-0941	3		RESISTOR 5.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5101-G
A12R35						
	0757-0955	9		RESISTOR 20K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2002-G
A12R36	0757-0955	9		RESISTOR 20K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2002-G
A12R37	0757-0955	9		RESISTOR 20K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2002-G
A12R38	0757-0955	9		RESISTOR 20K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2002-G
A12R39	0757-0937	7	6	RESISTOR 3.6M 2% .125W F TC=0+-100	24546	C4-1/8-T0-3601-G
A12R40						

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-1. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A12R41	0757-0924	2		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A12R42	0757-0937	7		RESISTOR 3.6K 2% .125W F TC=0+-100	24546	C4-1/8-T0-3601-G
A12R43	0757-0924	2		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A12R44	0757-0955	9		RESISTOR 20K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2002-G
A12R45	0757-0931	1		RESISTOR 2K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2001-G
A12U1	1820-0616	5		IC MUXR/DATA-SEL TTL 2-TO-1-LINE QUAD	07263	9322PC
A12U2	1820-1028	5	1	IC (MISC ITEM)	01295	SN7489N
A12U3	1820-0539	1	1	IC GFR TTL NAND QUAD 2-INP	01295	SN7437N
A12U4	1820-0471	0		IC INV TTL HEX 1-INP	01295	SN7406N
A12U5	1820-0839	4	1	IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN74175N
A12U6	1820-0716	6		IC CNTR TTL 8IN SYNCHRO POS-EDGE-TRIG	01295	SN74161N
A12U7	1820-0716	6		IC CNTR TTL 8IN SYNCHRO POS-EDGE-TRIG	01295	SN74161N
A12U8	1820-0782	6		IC GATE TTL NOR TPL 3-INP	01295	SN7427N
A12U9	1820-0683	6		IC INV TTL S HEX 1-INP	01295	SN74804N
A12U10	1820-0693	0		IC FF TTL S D-TYPE POS-EDGE-TRIG	01295	SN74874N
A12U11	1820-0367	3		IC SHF-RGTR TTL R-S PRL-IN PRL-OUT 4-BIT	01295	SN7495AN
A12U12	1820-1184	4	1	IC GFR TTL NOR QUAD 2-INP	01295	SN74128N
A12U13	1820-0685	8		IC GATE TTL S NAND TPL 3-INP	01295	SN74810N
A12U14	1820-0328	6		IC GATE TTL NOR QUAD 2-INP	01295	SN7402N
A12U15	1826-0055	8	4	COMPARATOR GP DUAL 14-DIP-C	07263	711DC
A12U16	1826-0055	8		COMPARATOR GP DUAL 14-DIP-C	07263	711DC
A12U17	1820-1615	6	1	IC	04713	MC14049BCP
A12U18	1820-0468	3	1	IC DCDR TTL BCD-TO-DEC 4-TO-10-LINE	01295	SN7445N
A12U19	1826-0055	8		COMPARATOR GP DUAL 14-DIP-C	07263	711DC
A12U20	1826-0055	8		COMPARATOR GP DUAL 14-DIP-C	07263	711DC
	1250-1368	7	6	CONNECTOR-RF SMB M PC 50-OHM	28480	1250-1368
	1480-0116	8		PIN-GRV .062-IN-DIA .25-IN-LG STL	28480	1480-0116
	4040-0747	2	2	EXTR-PC BD GRA POLYC .062-BD-THKNS	28480	4040-0747
A13	05045-60013	0	1	BOARD ASSEMBLY, PIN DRIVER (SERIES 1916)	28480	05045-60013
A13C1	0160-2201	7		CAPACITOR-FXD 51PF +-5% 300VDC MICA	28480	0160-2201
A13C2	0170-0094	3	8	CAPACITOR-FXD .047UF +-20% 50VDC POLYE	84411	602-4730R5W2
A13C3	0170-0094	3		CAPACITOR-FXD .047UF +-20% 50VDC POLYE	84411	602-4730R5W2
A13C4	0160-2201	7		CAPACITOR-FXD 51PF +-5% 300VDC MICA	28480	0160-2201
A13C5	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A13C6	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A13C7	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A13C8	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A13C9	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A13C10	0160-2201	7		CAPACITOR-FXD 51PF +-5% 300VDC MICA	28480	0160-2201
A13C11	0170-0094	3		CAPACITOR-FXD .047UF +-20% 50VDC POLYE	84411	602-4730R5W2
A13C12	0170-0094	3		CAPACITOR-FXD .047UF +-20% 50VDC POLYE	84411	602-4730R5W2
A13C13	0160-2201	7		CAPACITOR-FXD 51PF +-5% 300VDC MICA	28480	0160-2201
A13C14	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A13C15	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A13C16	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A13C17	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A13C18	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A13C19	0160-2204	0	10	CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A13C20	0160-3454	4	4	CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A13C21	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A13C22	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A13C23	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A13C24	0150-0071	4	4	CAPACITOR-FXD 400PF +-5% 1KVDC CER	28480	0150-0071
A13C25	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A13C26	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A13C27	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A13C28	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A13C29	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A13C30	0160-2199	2	8	CAPACITOR-FXD 39PF +-5% 300VDC MICA	28480	0160-2199
A13C31	0160-2199	2		CAPACITOR-FXD 39PF +-5% 300VDC MICA	28480	0160-2199
A13C32	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A13C33	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A13C34	0160-2199	2		CAPACITOR-FXD 39PF +-5% 300VDC MICA	28480	0160-2199
A13C35	0160-2199	2		CAPACITOR-FXD 39PF +-5% 300VDC MICA	28480	0160-2199
A13C36	0170-0094	3		CAPACITOR-FXD .047UF +-20% 50VDC POLYE	84411	602-4730R5W2
A13C37	0170-0094	3		CAPACITOR-FXD .047UF +-20% 50VDC POLYE	84411	602-4730R5W2
A13C38	0160-2199	2		CAPACITOR-FXD 39PF +-5% 300VDC MICA	28480	0160-2199
A13C39	0160-2199	2		CAPACITOR-FXD 39PF +-5% 300VDC MICA	28480	0160-2199
A13C40	0170-0094	3		CAPACITOR-FXD .047UF +-20% 50VDC POLYE	84411	602-4730R5W2
A13C41	0170-0094	3		CAPACITOR-FXD .047UF +-20% 50VDC POLYE	84411	602-4730R5W2
A13C42	0150-0071	4		CAPACITOR-FXD 400PF +-5% 1KVDC CER	28480	0150-0071
A13C43	0150-0071	4		CAPACITOR-FXD 400PF +-5% 1KVDC CER	28480	0150-0071
A13C44	0150-0071	4		CAPACITOR-FXD 400PF +-5% 1KVDC CER	28480	0150-0071
A13C45	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-1. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A13C46	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A13C47	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A13C48	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A13CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A13CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A13CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A13CR4	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A13CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A13CR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A13CR7	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A13CR8	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A13CR9	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A13CR10	1902-3193	3	4	DIODE-ZNR 13.3V 5% DO-7 PD*.4W TC*+.059%	28480	1902-3193
A13CR11	1902-3193	3		DIODE-ZNR 13.3V 5% DO-7 PD*.4W TC*+.059%	28480	1902-3193
A13CR12	1902-3193	3		DIODE-ZNR 13.3V 5% DO-7 PD*.4W TC*+.059%	28480	1902-3193
A13CR13	1902-3193	3		DIODE-ZNR 13.3V 5% DO-7 PD*.4W TC*+.059%	28480	1902-3193
A13CR14	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A13CR15	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A13CR16	1901-0518	8	6	DIODE-SCHOTTKY	28480	1901-0518
A13CR17	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
A13CR19	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A13CR20	1910-0034	2	3	DIODE-GE 30V 80MA 8NS DO-7	28480	1910-0034
A13CR21	1901-0040	1	108	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A13CR22	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A13CR23	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A13CR24	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A13CR25	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A13CR26	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A13CR27	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A13CR28	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A13CR29	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A13CR30	1901-0050	3		DIODE-GE 30V 80MA 8NS DO-7	28480	1910-0034
A13CR31	1910-0034	2		DIODE-GE 30V 80MA 8NS DO-7	28480	1910-0034
A13CR32	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
A13CR33	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
A13CR34	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
A13CR35	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
A13CR36	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
A13Q1	1854-0071	7	2	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A13Q2	1854-0634	8		TRANSISTOR NPN SI PD=1W FT=50MHZ	04713	MPS-U01
A13Q3	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A13Q4	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A13Q5	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A13Q6	1854-0671	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A13Q7	1854-0634	8		TRANSISTOR NPN SI PD=1W FT=50MHZ	04713	MPS-U01
A13Q8	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A13Q9	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A13Q10	1853-0326	3	2	TRANSISTOR PNP SI PD=1W FT=50MHZ	04713	MPS-U51
A13Q11	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A13Q12	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A13Q13	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A13Q14	1853-0326	3		TRANSISTOR PNP SI PD=1W FT=50MHZ	04713	MPS-U51
A13Q15	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A13Q16	1853-0020	4	2	TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A13Q17	1854-0670	2		TRANSISTOR NPN SI DARL PD=50W	01295	TIP110
A13Q18	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A13Q19	1854-0670	2		TRANSISTOR NPN SI DARL PD=50W	01295	TIP110
A13Q20	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A13Q21	1853-0020	4	2	TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A13Q22	1853-0377	4		TRANSISTOR PNP SI DARL PD=50W	01295	TIP 115
A13Q23	1853-0377	4		TRANSISTOR PNP SI DARL PD=50W	01295	TIP 115
A13Q24	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A13R1	0757-0909	3	2	RESISTOR 240 2% .125W F TC=0+-100	24546	C4-1/8-T0-241-G
A13R2	0757-0909	3		RESISTOR 240 2% .125W F TC=0+-100	24546	C4-1/8-T0-241-G
A13R3	0757-0907	1		RESISTOR 200 2% .125W F TC=0+-100	24546	C4-1/8-T0-201-G
A13R4	0757-0283	6	8	RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A13R5	0811-3453	9	4	RESISTOR 25 1% 3W PW TC=0+-20	28480	0811-3453
A13R6	0757-0283	6	9	RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A13R7	0757-0974	2		RESISTOR 120K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1202-G
A13R8	0811-3453	9	4	RESISTOR 25 1% 3W PW TC=0+-20	28480	0811-3453
A13R9	0757-0974	2		RESISTOR 120K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1202-G
A13R10	0757-0918	4	4	RESISTOR 560 2% .125W F TC=0+-100	24546	C4-1/8-T0-561-G
A13R11	0757-0965	1		RESISTOR 51K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5102-G
A13R12	0757-0918	4		RESISTOR 560 2% .125W F TC=0+-100	24546	C4-1/8-T0-561-G
A13R13	0757-0965	1		RESISTOR 51K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5102-G
A13R14	0757-0907	1		RESISTOR 200 2% .125W F TC=0+-100	24546	C4-1/8-T0-201-G
A13R15	0757-0974	2		RESISTOR 120K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1202-G

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-1. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A13R16	0757-0974	2		RESISTOR 120K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1202-G
A13R17	0811-3453	4		RESISTOR 2S 1% 3W PW TC=0+-20	28480	0811-3453
A13R18	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A13R19	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A13R20	0811-3453	4		RESISTOR 2S 1% 3W PW TC=0+-20	28480	0811-3453
A13R21	0757-0918	4		RESISTOR 560 2% .125W F TC=0+-100	24546	C4-1/8-T0-561-G
A13R22	0757-0965	1		RESISTOR 51K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5102-G
A13R23	0757-0965	1		RESISTOR 51K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5102-G
A13R24	0757-0918	4		RESISTOR 560 2% .125W F TC=0+-100	24546	C4-1/8-T0-561-G
A13R25	0757-0948	0		RESISTOR 10K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
A13R26	0757-0948	0		RESISTOR 10K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
A13R27	0757-0948	0		RESISTOR 10K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
A13R28	0757-0948	0		RESISTOR 10K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1002-G
A13R29	0757-0937	7		RESISTOR 3.6K 2% .125W F TC=0+-100	24546	C4-1/8-T0-3601-G
A13R30	0757-0923	1	4	RESISTOR 910 2% .125W F TC=0+-100	24546	C4-1/8-T0-911-G
A13R31	0757-0923	1		RESISTOR 910 2% .125W F TC=0+-100	24546	C4-1/8-T0-911-G
A13R32	0757-0923	1		RESISTOR 910 2% .125W F TC=0+-100	24546	C4-1/8-T0-911-G
A13R33	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A13R34	0757-0955	9		RESISTOR 20K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2002-G
A13R35	0757-0976	4		RESISTOR 150K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1502-G
A13R36	0757-0924	2		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A13R37	0757-0976	4		RESISTOR 150K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1502-G
A13R38	0757-0955	9		RESISTOR 20K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2002-G
A13R39	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A13R40	0757-0911	7		RESISTOR 300 2% .125W F TC=0+-100	24546	C4-1/8-T0-301-G
A13R41	0757-0937	7		RESISTOR 3.6K 2% .125W F TC=0+-100	24546	C4-1/8-T0-3601-G
A13R42	0757-0924	2		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A13R43	0698-3457	6	4	RESISTOR 316K 1% .125W F TC=0+-100	28480	0698-3457
A13R44	0757-0976	4		RESISTOR 150K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1502-G
A13R45	0698-3457	6		RESISTOR 316K 1% .125W F TC=0+-100	28480	0698-3457
A13R46	0757-0937	7		RESISTOR 3.6K 2% .125W F TC=0+-100	24546	C4-1/8-T0-3601-G
A13R47	0757-0924	2		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A13R48	0757-0924	2		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A13R49	0757-0976	4		RESISTOR 150K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1502-G
A13R50	0757-0937	7		RESISTOR 3.6K 2% .125W F TC=0+-100	24546	C4-1/8-T0-3601-G
A13R51	0757-0911	7		RESISTOR 300 2% .125W F TC=0+-100	24546	C4-1/8-T0-301-G
A13R52	0757-0911	7		RESISTOR 300 2% .125W F TC=0+-100	24546	C4-1/8-T0-301-G
A13R53	0757-0923	1		RESISTOR 910 2% .125W F TC=0+-100	24546	C4-1/8-T0-911-G
A13R54	0757-0924	2		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A13R55	0698-3457	6		RESISTOR 316K 1% .125W F TC=0+-100	28480	0698-3457
A13R56	0757-0924	2		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A13R57	0698-3457	6		RESISTOR 316K 1% .125W F TC=0+-100	28480	0698-3457
A13R58	0757-0911	7		RESISTOR 300 2% .125W F TC=0+-100	24546	C4-1/8-T0-301-G
A13R59	0757-0955	9		RESISTOR 20K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2002-G
A13R60	0757-0955	9		RESISTOR 20K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2002-G
A13R61	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A13R62	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A13U1	1826-0311	9	8	OP AMP GP 8-DIP-P	04713	MLM201AP1
A13U2	1820-1619	0	2	IC GATE CMOS EXCL-OR/NOR TPL 3-INP	04713	MC14025UBCP
A13U3	1826-0311	9		OP AMP GP 8-DIP-P	04713	MLM201AP1
A13U4	1820-1618	9	2	IC GATE CMOS NAND TPL 3-INP	04713	MC14023UBCP
A13U5	1820-1620	3	3	IC GATE CMOS NOR QUAD 2-INP	04713	MC14001UBCP
A13U6	1820-1621	4	1	IC GATE CMOS NAND QUAD 2-INP	04713	MC14011UBCP
A13U7	1826-0311	9		OP AMP GP 8-DIP-P	04713	MLM201AP1
A13U8	1826-0311	9		OP AMP GP 8-DIP-P	04713	MLM201AP1
A13U9	1826-0311	9		OP AMP GP 8-DIP-P	04713	MLM201AP1
A13U10	1826-0311	9		OP AMP GP 8-DIP-P	04713	MLM201AP1
A13U11	1826-0311	9		OP AMP GP 8-DIP-P	04713	MLM201AP1
A13U12	1820-1619	0		IC GATE CMOS EXCL-OR/NOR TPL 3-INP	04713	MC14025UBCP
A13U13	1826-0311	9		OP AMP GP 8-DIP-P	04713	MLM201AP1
A13U14	1820-1618	9		IC GATE CMOS NAND TPL 3-INP	04713	MC14023UBCP
A13U15	1820-1620	3		IC GATE CMOS NOR QUAD 2-INP	04713	MC14001UBCP
A13U16	1820-1938	6		IC	28480	1820-1938
A13U17	1820-1938	6		IC	28480	1820-1938
A13U18	1820-1614	5	5	IC, CMOS, 4016A 4D	28480	1820-1614
A13U19	1820-1614	5		IC, CMOS, 4016A 4D	28480	1820-1614
A13U20	1820-1620	3		IC GATE CMOS NOR QUAD 2-INP	04713	MC14001UBCP
A13U21	1820-1614	5		IC, CMOS, 4016A 4D	28480	1820-1614
A13U22	1820-1617	8		IC CMOS DUAL D F-F POS EDGE CLOCK	04713	MC14013BCP
A13U23	1820-1614	5		IC, CMOS, 4016A 4D	28480	1820-1614
A13U24	1820-1614	5		IC, CMOS, 4016A 4D	28480	1820-1614
A13U25	1820-1938	6		IC	28480	1820-1938
A13U26	1820-1938	6		IC	28480	1820-1938

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-1. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
	0340-0579	0	1	INSULATOR RUBBER RED	28480	0340-0579
	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
	0570-0125	9	4	SCREW-MACH 4-40 .188-IN-LG BDG-HD-SLT	00000	ORDER BY DESCRIPTION
	1480-0116	8		PIN-GRV .062-IN-DIA .25-IN-LG STL	28480	1480-0116
	4040-0710	9	2	EXTR-PC BD BLK POLYC .07-BD-THKNS	28480	4040-0710
	2360-0055	1	4	SCREW-MACH 6-32 .188-IN-LG BDG-HD-SLT	00000	ORDER BY DESCRIPTION
	05045-20202	5	1	HEAT SINK	28480	05045-20202
A14				SAME AS A13, USE PREFIX A14		
A15				SAME AS A13, USE PREFIX A15		
A16				SAME AS A13, USE PREFIX A16		
A17				SAME AS A13, USE PREFIX A17(OPTION 024)		
A18				SAME AS A13, USE PREFIX A18(OPTION 024)		
A19				SAME AS A13, USE PREFIX A19(OPTION 024)		
A20				SAME AS A13, USE PREFIX A20(OPTION 024)		
A21				SAME AS A13, USE PREFIX A21		
A22				SAME AS A13, USE PREFIX A22		
A23				SAME AS A13, USE PREFIX A23		
A24				SAME AS A13, USE PREFIX A24		
A25	09810-66562	[1]	1	CARD READER INTERFACE ASSEMBLY THE CARD READER INTERFACE AND THE SENSOR ASSEMBLY ARE AN EXCHANGE ITEM, ORDERED BY PART NUMBER 09810-67960. THE REPLACEMENT PARTS ARE LISTED BELOW FOR REFERENCE ONLY.	28480	09810-66562
A25C1	0160-0228	6	8	CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	1500226X9015B2
A25C2	0160-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	1500226X9015B2
A25C3	0160-0128	3	2	CAPACITOR-FXD 2.2UF +-20% 50VDC CER	28480	0160-0128
A25C4	0160-0128	3		CAPACITOR-FXD 2.2UF +-20% 50VDC CER	28480	0160-0128
A25C5	0160-0174	9	1	CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A25C6	0150-0084	9	3	CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0150-0084
A25C7	0150-0084	9		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0150-0084
A25C40	0160-3847	9		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3847
A25C100	0160-0228	6	4	CAPACITOR-FXD .01UF +100-0% 50VDC CER	56289	1500226X9015B2
A25C101	0160-2001	5	5	CAPACITOR-FXD 22UF+-10% 15VDC TA	28480	0160-2001
A25C102	0160-2204	0		CAPACITOR-FXD 50PF +-1% 500VDC MICA	28480	0160-2204
A25C103	0160-3847	9		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-3847
A25C200	0160-0226	6		CAPACITOR-FXD .01UF +100-0% 50VDC CER	56289	1500226X9015B2
A25C201	0160-2001	5		CAPACITOR-FXD 22UF+-10% 15VDC TA	28480	0160-2001
A25C202	0160-2204	0		CAPACITOR-FXD 50PF +-1% 500VDC MICA	28480	0160-2204
A25C203	0160-3847	9		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-3847
A25C300	0160-0226	6		CAPACITOR-FXD .01UF +100-0% 50VDC CER	56289	1500226X9015B2
A25C301	0160-2001	5		CAPACITOR-FXD 22UF+-10% 15VDC TA	28480	0160-2001
A25C302	0160-2204	0		CAPACITOR-FXD 50PF +-1% 500VDC MICA	28480	0160-2204
A25C303	0160-3847	9		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-3847
A25C400	0180-0228	6		CAPACITOR-FXD .01UF +100-0% 50VDC CER	56289	1500226X9015B2
A25C401	0160-2001	5		CAPACITOR-FXD 22UF+-10% 15VDC TA	28480	0160-2001
A25C402	0160-2204	0		CAPACITOR-FXD 50PF +-1% 500VDC MICA	28480	0160-2204
A25C403	0140-0196	3		CAPACITOR-FXD 100PF +-5% 300VDC MICA	72136	DM15F151J0300WVICR
A25C404			1	CAPACITOR-FXD 150PF +-1% 500VDC MICA	28480	0160-2001
A25C405	0160-2001	5				
A25CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A25CR10	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A25CR12	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A25CR20	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A25CR22				DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A25CR23	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A25CR30	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A25CR32	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A25CR40	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A25CR42						

Table 6-1. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A25CR99	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A25CR100	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A25CR101	1902-0041	4	4	DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=+.009%	28480	1902-0041
A25CR102	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A25CR103	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A25CR105	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A25CR106	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A25CR200	1902-0041	4		DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=+.009%	28480	1902-0041
A25CR201	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A25CR202	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A25CR203	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A25CR204	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A25CR300	1902-0041	4		DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=+.009%	28480	1902-0041
A25CR301	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A25CR302	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A25CR303	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A25CR304	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A25CR400	1902-0041	4		DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=+.009%	28480	1902-0041
A25CR401	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A25CR402	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A25CR403	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A25CR405	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A25CR406	1854-0404	0	26	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A25Q1	1853-0010	2	12	TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0010
A25Q2	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A25Q11	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A25Q12	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A25Q21	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A25Q22	1853-0010	2		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0010
A25Q23	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A25Q31	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A25Q32	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A25Q41	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A25Q42	1853-0010	2		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0010
A25Q43	1853-0010	2		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0010
A25Q44	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A25Q45	1853-0010	2		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A25Q101	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A25Q103	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A25Q104	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A25Q105	1853-0010	2		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0010
A25Q106	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A25Q107	1853-0010	2		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0010
A25Q201	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A25Q203	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A25Q204	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A25Q205	1853-0010	2		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0010
A25Q206	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A25Q207	1853-0010	2		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0010
A25Q301	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A25Q303	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A25Q304	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A25Q305	1853-0010	2		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0010
A25Q306	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A25Q307	1853-0010	2		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0010
A25Q401	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A25Q403	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A25Q404	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A25Q405	1853-0010	2		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0010
A25Q406	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A25Q407	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A25R1	0684-1031	9	18	RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A25R2	0684-1021	7	7	RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A25R3	1684-1031	0	1	RESISTOR 470 10% .25W FC TC=-400/+600	28480	1684-1031
A25R4	0684-4711	8	1	RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB4711
A25R7	0684-1021	7			01121	CB1021
A25R8	0684-2231	3	6	RESISTOR 22K 10% .25W FC TC=-400/+800	01121	CB2231
A25R10	0698-5101	1	4	RESISTOR 33 10% .25W FC TC=-400/+500	01121	CB3301
A25R11	0684-2241	5	4	RESISTOR 220K 10% .25W FC TC=-800/+900	01121	CB2241
A25R12	0684-1031	9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A25R13	0684-4731	2	7	RESISTOR 47K 10% .25W FC TC=-400/+800	01121	CB4731
A25R20	0698-5101	1		RESISTOR 33 10% .25W FC TC=-400/+500	01121	CB3301
A25R21	0684-2241	5		RESISTOR 220K 10% .25W FC TC=-800/+900	01121	CB2241
A25R22	0684-1031	9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A25R23	0684-4731	2		RESISTOR 47K 10% .25W FC TC=-400/+800	01121	CB4731
A25R26	0684-1041	1	8	RESISTOR 100K 10% .25W FC TC=-400/+800	01121	CB1041

Table 6-1. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A25R25	0684-1031	9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A25R30	0698-5101	1		RESISTOR 33 10% .25W FC TC=-400/+500	01121	CB3301
A25R31	0684-2241	5		RESISTOR 220K 10% .25W FC TC=-800/+900	01121	CB2241
A25R32	0684-1031	9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A25R33	0684-4731	2		RESISTOR 47K 10% .25W FC TC=-400/+800	01121	CB4731
A25R40	0698-5101	1		RESISTOR 33 10% .25W FC TC=-400/+500	01121	CB3301
A25R41	0684-2241	5		RESISTOR 220K 10% .25W FC TC=-800/+900	01121	CB2241
A25R42	0684-1031	9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A25R43	0684-4731	2		RESISTOR 47K 10% .25W FC TC=-400/+800	01121	CB4731
A25R44	0684-1041	1		RESISTOR 100K 10% .25W FC TC=-400/+800	01121	CB1041
A25R45	0684-1031	9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A25R46	0684-3331	6	1	RESISTOR 33K 10% .25W FC TC=-400/+800	01121	CB3331
A25R47	0684-2231	3		RESISTOR 22K 10% .25W FC TC=-400/+700	01121	CB2231
A25R48	0684-1031	9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A25R49	0684-2231	3		RESISTOR 22K 10% .25W FC TC=-400/+800	01121	CB2231
A25R50	0684-4721	0	4	RESISTOR 4.7K 10% .25W FC TC=-400/+700	01121	CB4721
A25R101	0684-1031	9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A25R102	0684-1031	9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A25R103	0684-2721	6	4	RESISTOR 2.7K 10% .25W FC TC=-400/+700	01121	CB2721
A25R104	0684-1221	9	4	RESISTOR 1.2K 10% .25W FC TC=-400/+700	01121	CB1221
A25R106	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A25R107	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A25R108	0698-4519	3	4	RESISTOR 140K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1403-F
A25R109	0698-4500	2	4	RESISTOR 57.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5762-F
A25R110	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A25R111	0757-0453	2	4	RESISTOR 30.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3012-F
A25R112	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A25R113	0684-1051	3	7	RESISTOR 1M 10% .25W FC TC=-800/+900	01121	CB1051
A25R114	0698-4211	2	4	RESISTOR 158K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1583-F
A25R115	0684-1041	1		RESISTOR 100K 10% .25W FC TC=-400/+800	01121	CB1041
A25R116	0698-4509	1	4	RESISTOR 80.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8062-F
A25R117	0698-4505	7		RESISTOR 71.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7152-F
A25R118	0684-1051	3		RESISTOR 1M 10% .25W FC TC=-800/+900	01121	CB1051
A25R119	0684-2231	3		RESISTOR 22K 10% .25W FC TC=-400/+800	01121	CB2231
A25R120	0684-4731	2		RESISTOR 47K 10% .25W FC TC=-400/+800	01121	CB4731
A25R121	0684-4721	0		RESISTOR 4.7K 10% .25W FC TC=-800/+700	01121	CB4721
A25R123	0684-1021	7		RESISTOR 1K 10% .25W FC TC=-400/+700	01121	CB1021
A25R201	0684-1031	9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A25R202	0684-1031	9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A25R203	0684-2721	6		RESISTOR 2.7K 10% .25W FC TC=-400/+700	01121	CB2721
A25R204	0684-1221	9		RESISTOR 1.2K 10% .25W FC TC=-400/+700	01121	CB1221
A25R206	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A25R207	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A25R208	0698-4519	3		RESISTOR 140K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1403-F
A25R209	0698-4500	2		RESISTOR 57.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5762-F
A25R210	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A25R211	0757-0453	2		RESISTOR 30.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3012-F
A25R212	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A25R213	0684-1051	3		RESISTOR 1M 10% .25W FC TC=-800/+900	01121	CB1051
A25R214	0698-4211	2		RESISTOR 158K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1583-F
A25R215	0684-1041	1		RESISTOR 100K 10% .25W FC TC=-400/+800	01121	CB1041
A25R216	0698-4509	1		RESISTOR 80.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8062-F
A25R217	0698-4505	7		RESISTOR 71.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7152-F
A25R218	0684-1051	3		RESISTOR 1M 10% .25W FC TC=-800/+900	01121	CB1051
A25R219	0684-2231	3		RESISTOR 22K 10% .25W FC TC=-400/+800	01121	CB2231
A25R220	0684-4731	2		RESISTOR 47K 10% .25W FC TC=-400/+800	01121	CB4731
A25R221	0684-4721	0		RESISTOR 4.7K 10% .25W FC TC=-400/+700	01121	CB4721
A25R223	0684-1021	7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A25R301	0684-1031	9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A25R302	0684-1031	9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A25R303	0684-2721	6		RESISTOR 2.7K 10% .25W FC TC=-400/+700	01121	CB2721
A25R304	0684-1221	9		RESISTOR 1.2K 10% .25W FC TC=-400/+700	01121	CB1221
A25R306	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A25R307	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A25R308	0698-4519	3		RESISTOR 140K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1403-F
A25R309	0698-4500	2		RESISTOR 57.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5762-F
A25R310	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A25R311	0757-0453	2		RESISTOR 30.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3012-F
A25R312	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A25R313	0684-1051	3		RESISTOR 1M 10% .25W FC TC=-800/+900	01121	CB1051
A25R314	0698-4211	2		RESISTOR 158K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1583-F
A25R315	0684-1041	1		RESISTOR 100K 10% .25W FC TC=-400/+800	01121	CB1041
A25R316	0698-4509	1		RESISTOR 80.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8062-F
A25R317	0698-4505	7		RESISTOR 71.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7152-F
A25R318	0684-1051	3		RESISTOR 1M 10% .25W FC TC=-800/+900	01121	CB1051

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-1. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A25R319	0684-2231	3		RESISTOR 22K 10% .25W FC TC=-400/+800	01121	CB2231
A25R320	0684-4731	2		RESISTOR 47K 10% .25W FC TC=-400/+800	01121	CB4731
A25R321	0684-4721	0		RESISTOR 4.7K 10% .25W FC TC=-400/+700	01121	CB4721
A25R323	0684-1021	7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A25R401	0684-1031	9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A25R402	0684-1031	9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A25R403	0684-2721	6		RESISTOR 2.7K 10% .25W FC TC=-400/+700	01121	CB2721
A25R404	0684-1221	9		RESISTOR 1.2K 10% .25W FC TC=-400/+700	01121	CB1221
A25R406	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A25R407	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A25R408	0698-4519	3		RESISTOR 140K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1403-F
A25R409	0698-4500	2		RESISTOR 57.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5762-F
A25R410	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A25R411	0757-0453	2		RESISTOR 30.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3012-F
A25R412	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A25R414	0698-4211	2		RESISTOR 158K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1583-F
A25R415	0684-1041	1		RESISTOR 100K 10% .25W FC TC=-400/+800	01121	CB1041
A25R416	0698-4509	1		RESISTOR 80.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8062-F
A25R417	0698-4505	7		RESISTOR 71.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7152-F
A25R418	0684-1031	9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A25R418	0684-1051	3		RESISTOR 1M 10% .25W FC TC=-800/+900	01121	CB1051
A25R419	0684-1041	1		RESISTOR 100K 10% .25W FC TC=-400/+800	01121	CB1041
A25R420	0684-1021	7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A25R421	0684-1041	1		RESISTOR 100K 10% .25W FC TC=-400/+800	01121	CB1041
A25R422	0684-1031	9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A25R423	0684-1021	7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A25U1	1820-0077	2		IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN7474N
A25U2	1820-0077	2		IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN7474N
A25U3	1820-0471	0		IC INV TTL HEX 1-INP	01295	SN7406N
A25U4	1820-0077	2		IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN7474N
A25U5	1820-0175	1	1	IC INV TTL HEX 1-INP	01295	SN7405N
A25U6	1820-0077	2		IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN7474N
A25U7	1820-0077	2		IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN7474N
A25U100	1820-0203	6	4	OP AMP GP TO-99	01928	CA741CT
A25U200	1820-0203	6		OP AMP GP TO-99	01928	CA741CT
A25U300	1820-0203	6		OP AMP GP TO-99	01928	CA741CT
A25U400	1820-0203	6		OP AMP GP TO-99	01928	CA741CT
				MISCELLANEOUS PARTS		
	1251-1636	4	1	CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-1636
	4040-0750	7		EXTR-PC SD RED POLYC .062-SD-TMKNS	28480	4040-0750
A25Z4	09820-24761	6	1	SPACER, CAPTIVE	28480	09820-24761
A26	05045-60015	2		CARD READER/PRINTER INTERFACE ASSEMBLY (SERIES 1652)	28480	05045-60015
A26C1	0180-0291	3	1	CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A26C2	0180-0373	2	1	CAPACITOR-FXD .68UF+-10% 35VDC TA	56289	150D684X9035A2
A26C3	0180-0210	6		CAPACITOR-FXD 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
A26C4	0180-0195	6	3	CAPACITOR-FXD .33UF+-20% 35VDC TA	56289	150D334X0035A2
A26C5	0180-0195	6		CAPACITOR-FXD .33UF+-20% 35VDC TA	56289	150D334X0035A2
A26C6	0180-0195	6		CAPACITOR-FXD .33UF+-20% 35VDC TA	56289	150D334X0035A2
A26C7	0180-0210	6		CAPACITOR-FXD 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
A26CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A26CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A26CR3	1901-0029	6	1	DIODE-PWR RECT 600V 750MA DO-29	28480	1901-0029
A26CR4	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A26CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A26CR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A26CR7	1902-0044	3	1	DIODE-ZNR 1N5363B 30V 5% PD=5W TC=+29MV	28480	1902-0044
A26J1	1251-3025	9	1	CONNECTOR 34-PIN M RECTANGULAR	28480	1251-3025
A26Q1	1853-0318	3	1	TRANSISTOR PNP SI PD=500MW FT=60MHZ	04713	MPS6562
A26Q2	1854-0449	3	1	TRANSISTOR NPN SI TO-39 PD=5W FT=1MHZ	28480	1854-0449
A26Q3	1853-0058	8	4	TRANSISTOR PNP SI PD=300MW FT=200MHZ	07263	S32248
A26Q4	1853-0058	8		TRANSISTOR PNP SI PD=300MW FT=200MHZ	07263	S32248
A26Q5	1853-0058	8		TRANSISTOR PNP SI PD=300MW FT=200MHZ	07263	S32248
A26Q6	1853-0058	8		TRANSISTOR PNP SI PD=300MW FT=200MHZ	07263	S32248
A26R1	0757-0941	3		RESISTOR 5.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5101-G
A26R2	1810-0041	9		NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0041
A26R3	0757-0970	8	1	RESISTOR 82K 2% .125W F TC=0+-100	24546	C4-1/8-T0-8202-G
A26R4	0757-0960	6	1	RESISTOR 33K 2% .125W F TC=0+-100	24546	C4-1/8-T0-3302-G
A26R5				NOT ASSIGNED		
A26R6	1810-0041	9		NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0041
A26R7	1810-0041	9		NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0041
A26R8	0757-0897	8	1	RESISTOR 75 2% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-G
A26R9	0757-0900	4		RESISTOR 100 2% .125W F TC=0+-100	24546	C4-1/8-T0-101-G
A26R10	0811-2822	9	1	RESISTOR 6.8 5% .75W PW TC=0+-50	91637	RW1/2-T2-6R8-J

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-1. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A26R11	0757-0893	4		RESISTOR 51 2% .125W F TC=0+-100	24546	C4-1/8-T0-51R0-G
A26R12	0757-0924	2		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A26R13	0757-0930	0	6	RESISTOR 1.8K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1801-G
A26R14	0757-0928	8		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A26R15	0686-2015	5	4	RESISTOR 200 5% .5W CC TC=0+529	01121	EB2015
A26R16	0686-2015	5		RESISTOR 200 5% .5W CC TC=0+529	01121	EB2015
A26R17	0686-2015	5		RESISTOR 200 5% .5W CC TC=0+529	01121	EB2015
A26R18	0757-0930	0		RESISTOR 1.8K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1801-G
A26R19	0757-0924	2		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A26R20	2100-2517	4	1	RESISTOR-TRMR 50K 10% C SIDE-ADJ 1-TRN	30983	ET50X503
A26R21	0757-0924	2		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A26R22	0757-0930	0		RESISTOR 1.8K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1801-G
A26R23	0757-0930	0		RESISTOR 1.8K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1801-G
A26R24	0757-0932	2		RESISTOR 2.2K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2201-G
A26R25	0757-0965	1		RESISTOR 51K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5102-G
A26R26	0360-0124	3	2	CONNECTOR-SGL CONT PIN .04-IN-BSC-SZ RND	28480	0360-0124
A26TP1	0360-0124	3		CONNECTOR-SGL CONT PIN .04-IN-BSC-SZ RND	28480	0360-0124
A26TP2	1820-0077	2	2	IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN7474N
A26U1	1820-0730	4		IC MV TTL L MONOSTBL RETRIG/RESET DUAL	07263	96L02DC
A26U2	1820-0294	5	2	IC SHF-RGTR TTL SERIAL-IN PRL-OUT 8-BIT	07263	74164PC
A26U3	1818-2103	4	1	IC	28480	1818-2103
A26U4	1820-0368	4		IC SHF-RGTR TTL P-S PRL-IN PRL-OUT 5-BIT	01295	SN7496N
A26U5	1820-0716	6		IC CNTR TTL SIN SYNCHRO POS-EDGE-TRIG	01295	SN74161N
A26U6	1820-0730	4		IC MV TTL L MONOSTBL RETRIG/RESET DUAL	07263	96L02DC
A26U7	1820-0294	5		IC SHF-RGTR TTL SERIAL-IN PRL-OUT 8-BIT	07263	74164PC
A26U8	1820-0368	4		IC SHF-RGTR TTL P-S PRL-IN PRL-OUT 5-BIT	01295	SN7496N
A26U9	1820-0077	2		IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN7474N
A26U10	1820-0077	2	1	IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN7474N
A26U11	1820-1017	2		IC DCDR TTL L 2-TO-4-LINE DUAL 2-INP	07263	93L21PC
A26U12	1820-0368	4		IC SHF-RGTR TTL R-S PRL-IN PRL-OUT 5-BIT	01295	SN7496N
A26U13	1820-0661	0		IC GATE TTL OR QUAD 2-INP	01295	SN7432N
A26U14	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A26U15	1820-0668	7	1	IC BFR TTL NON-INV HEX 1-INP	01295	SN7407N
A26U16	1820-0368	4		IC SHF-RGTR TTL R-S PRL-IN PRL-OUT 5-BIT	01295	SN7496N
A26U17	1820-0174	0		IC INV TTL HEX	01295	SN7404N
A26U18	1820-0367	3		IC SHF-RGTR TTL R-S PRL-IN PRL-OUT 4-BIT	01295	SN7495AN
A26U19	1820-0368	4		IC SHF-RGTR TTL R-S PRL-IN PRL-OUT 5-BIT	01295	SN7496N
A26U20	1205-0011	0	1	HEAT SINK TO-5/TO-39-CS	28480	1205-0011
	1480-0116	8		PIN-GRV .062-IN-DIA .25-IN-LG STL	28480	1480-0116
	4040-0752	9		EXTR-PC BD YEL POLYC .062-BD-THKNS	28480	4040-0752
A27	05045-60021	0	1	BOARD ASSEMBLY, FRONT PANEL SWITCH (SERIES 1712)	28480	05045-60021
A27C1	0180-0161	8	3	CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0180-0161
A27C2	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A27C3	0180-0161	8		CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0180-0161
A27C4	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	28480	0180-0161
A27C5	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A27C6	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A27C7	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A27C8	0757-0965	1		RESISTOR 51K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5102-G
A27R1	0757-0965	1		RESISTOR 51K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5102-G
A27R2	0757-0965	1		RESISTOR 51K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5102-G
A27R3	0757-0965	1		RESISTOR 51K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5102-G
A27R4	1810-0132	9	2	NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	91637	CSP09C-07-501J
A27R5	1810-0132	9		NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	91637	CSP09C-07-501J
A27R6	0757-0941	3		RESISTOR 5.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5101-G
A27R7	0757-0965	1		RESISTOR 51K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5102-G
A27R8	0757-0965	1		RESISTOR 51K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5102-G
A27R9	0757-0911	7		RESISTOR 300 2% .125W F TC=0+-100	24546	C4-1/8-T0-301-G
A27R10						
A27S1	3101-1916	8	5	SWITCH-PB SPDT MOM .1A	28480	3101-1916
A27S2	3101-0647	0	2	SWITCH-PB SPDT MOM 1A 120VAC	28480	3101-0647
A27S3	3101-1916	8		SWITCH-PB SPDT MOM .1A	28480	3101-1916
A27S4	3101-1917	9	3	SWITCH-TGL SUBMIN SPDT .02A 20VAC/DC PC	28480	3101-1917
A27S5	3101-1915	7	1	SWITCH-TGL SUBMIN SPDT .02A 20VAC/DC PC	28480	3101-1915
A27S6	3101-1916	8		SWITCH-PB SPDT MOM .1A	28480	3101-1916
A27S7	3101-0647	0		SWITCH-PB SPDT MOM 1A 120VAC	28480	3101-0647
A27S8	3101-1916	8		SWITCH-PB SPDT MOM .1A	28480	3101-1916
A27S9	3101-1917	9		SWITCH-TGL SUBMIN SPDT .02A 20VAC/DC PC	28480	3101-1917
A27S10	3101-1917	9		SWITCH-TGL SUBMIN SPDT .02A 20VAC/DC PC	28480	3101-1917

Table 6-1. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A27S11	3101-1916	8		SWITCH-PB SPDT MOM .1A	28480	3101-1916
A27U1	1820-0579	9	3	IC MV TTL MONOSTBL RETRIG DUAL	01295	SN74123N
A27U2	1820-0579	9		IC MV TTL MONOSTBL RETRIG DUAL	01295	SN74123N
A27U3	1820-0471	0		IC INV TTL HEX 1-INP	01295	SN7406N
A27U4	1820-0579	9		IC MV TTL MONOSTBL RETRIG DUAL	01295	SN74123N
A27U5	1820-0511	4		IC GATE TTL AND QUAD 2-INP	01295	SN7408N
A27U6	1820-1112	8	1	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
A27U7	1820-1056	9		IC SCHMITT-TRIG TTL NAND QUAD 2-INP	01295	SN74132N
A27U8	1820-0328	6		IC GATE TTL NOR QUAD 2-INP	01295	SN7402N
A27U9	1820-1433	6		IC SHF-RGTR TTL LS N-S SERIAL-IN PRL-OUT	01295	SN74LS164N
A27U10	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A27U11	1820-1002	3		IC SHF-RGTR TTL R-S PRL-IN SERIAL-OUT	01295	SN74165N
A27U12	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
A27U13	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
	0380-0771	8	4	STANDOFF-RVT-DN .625-IN-LG 6-32THD	28480	0380-0771
A28	05045-60017	4	1	BOARD ASSEMBLY, SOCKET DRIVER (SERIES 1916)	28480	05045-60017
A28C1	0160-3876	4	24	CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A28C2	0160-0575	4	25	CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A28C3	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A28C4	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A28C5	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A28C6	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A28C7	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A28C8	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A28C9	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A28C10	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A28C11	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A28C12	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A28C13	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A28C14	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A28C15	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A28C16	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A28C17	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A28C18	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A28C19	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A28C20	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A28C21	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A28C22	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A28C23	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A28C24	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A28C25	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A28C26	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A28C27	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A28C28	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A28C29	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A28C30	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A28C31	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A28C32	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A28C33	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A28C34	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A28C35	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A28C36	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A28C37	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A28C38	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A28C39	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A28C40	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A28C41	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A28C42	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A28C43	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A28C44	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A28C45	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A28C46	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A28C47	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A28C48	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A28CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A28CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A28CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A28CR4	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A28CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040

Table 6-1. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A28CR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A28CR7	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A28CR8	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A28CR9	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A28CR10	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A28CR11	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A28CR12	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A28CR13	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A28CR14	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A28CR15	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A28CR16	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A28CR17	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A28CR18	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A28CR19	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A28CR20	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A28CR21	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A28CR22	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A28CR23	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A28CR24	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A28L1	9100-2247	4	1	COIL-MLD 100NH 10% Q=34 .095DX.25LG-NOM	28480	9100-2247
A28L2	9140-0144	0		COIL-MLD 4.7UH 10% Q=45 .095DX.25LG-NOM	28480	9140-0144
A28L3	9140-0144	0		COIL-MLD 4.7UH 10% Q=45 .095DX.25LG-NOM	28480	9140-0144
A28L4	9140-0144	0		COIL-MLD 4.7UH 10% Q=45 .095DX.25LG-NOM	28480	9140-0144
A28L5	9140-0144	0		COIL-MLD 4.7UH 10% Q=45 .095DX.25LG-NOM	28480	9140-0144
A28L6	9140-0144	0		COIL-MLD 4.7UH 10% Q=45 .095DX.25LG-NOM	28480	9140-0144
A28L7	9140-0144	0		COIL-MLD 4.7UH 10% Q=45 .095DX.25LG-NOM	28480	9140-0144
A28L8	9140-0144	0		COIL-MLD 4.7UH 10% Q=45 .095DX.25LG-NOM	28480	9140-0144
A28L9	9140-0144	0		COIL-MLD 4.7UH 10% Q=45 .095DX.25LG-NOM	28480	9140-0144
A28L10	9140-0144	0		COIL-MLD 4.7UH 10% Q=45 .095DX.25LG-NOM	28480	9140-0144
A28L11	9140-0144	0		COIL-MLD 4.7UH 10% Q=45 .095DX.25LG-NOM	28480	9140-0144
A28L12	9140-0144	0		COIL-MLD 4.7UH 10% Q=45 .095DX.25LG-NOM	28480	9140-0144
A28P2	1251-3283	1	2	CONNECTOR 24-PIN F MICRONIBBON	28480	1251-3283
A28P4	1251-0101	6	1	CONNECTOR 50-PIN F MICRO RIBBON	28480	1251-0101
A28Q1	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A28Q2	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A28Q3	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A28Q4	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A28Q5	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A28Q6	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A28Q7	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A28Q8	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A28Q9	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A28Q10	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A28Q11	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A28Q12	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A28Q13	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A28Q14	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A28Q15	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A28Q16	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A28Q17	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A28Q18	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A28Q19	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A28Q20	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A28Q21	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A28Q22	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A28Q23	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A28Q24	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A28R1	0683-1055	5	24	RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A28R2	0683-1055	5		RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A28R3	0757-0917	3		RESISTOR 510 2% .125W F TC=0+-100	24546	C4-1/8-T0-511-G
A28R4	0683-1055	5		RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A28R5	0683-1055	5		RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A28R6	0757-0917	3		RESISTOR 510 2% .125W F TC=0+-100	24546	C4-1/8-T0-511-G
A28R7	0683-1055	5		RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A28R8	0683-1055	5		RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A28R9	0757-0917	3		RESISTOR 510 2% .125W F TC=0+-100	24546	C4-1/8-T0-511-G
A28R10	0683-1055	5		RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A28R11	0683-1055	5		RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A28R12	0757-0917	3		RESISTOR 510 2% .125W F TC=0+-100	24546	C4-1/8-T0-511-G
A28R13	0683-1055	5		RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A28R14	0683-1055	5		RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A28R15	0683-1055	5		RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A28R16	0683-1055	5		RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A28R17	0757-0917	3		RESISTOR 510 2% .125W F TC=0+-100	24546	C4-1/8-T0-511-G
A28R18	0757-0917	3		RESISTOR 510 2% .125W F TC=0+-100	24546	C4-1/8-T0-511-G
A28R19	0683-1055	5		RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A28R20	0683-1055	5		RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-1. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A28R21	0757-0917	3		RESISTOR 510 2% .125W F TC=0+-100	24546	C4-1/8-T0-511-G
A28R22	0683-1055	5		RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A28R23	0683-1055	5		RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A28R24	0757-0917	3		RESISTOR 510 2% .125W F TC=0+-100	24546	C4-1/8-T0-511-G
A28R25	0683-1055	5		RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A28R26	0683-1055	5		RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A28R27	0757-0917	3		RESISTOR 510 2% .125W F TC=0+-100	24546	C4-1/8-T0-511-G
A28R28	0683-1055	5		RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A28R29	0683-1055	5		RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A28R30	0757-0917	3		RESISTOR 510 2% .125W F TC=0+-100	24546	C4-1/8-T0-511-G
A28R31	0683-1055	5		RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A28R32	0683-1055	5		RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A28R33	0683-1055	5		RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A28R34	0683-1055	5		RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A28R35	1810-0030	6		NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0030
A28R36	0683-5125	8	12	RESISTOR 5.1K 5% .25W FC TC=-400/+700	01121	CB5125
A28R37	0683-5125	8		RESISTOR 5.1K 5% .25W FC TC=-400/+700	01121	CB5125
A28R38	0683-5125	8		RESISTOR 5.1K 5% .25W FC TC=-400/+700	01121	CB5125
A28R39	0757-0917	3		RESISTOR 510 2% .125W F TC=0+-100	24546	C4-1/8-T0-511-G
A28R40	0757-0917	3		RESISTOR 510 2% .125W F TC=0+-100	24546	C4-1/8-T0-511-G
A28R41	0683-5125	8		RESISTOR 5.1K 5% .25W FC TC=-400/+700	01121	CB5125
A28R42	0683-5125	8		RESISTOR 5.1K 5% .25W FC TC=-400/+700	01121	CB5125
A28R43	0683-5125	8		RESISTOR 5.1K 5% .25W FC TC=-400/+700	01121	CB5125
A28R44	1810-0030	6		NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0030
A28R45	0683-5125	8		RESISTOR 5.1K 5% .25W FC TC=-400/+700	01121	CB5125
A28R46	0683-5125	8		RESISTOR 5.1K 5% .25W FC TC=-400/+700	01121	CB5125
A28R47	0683-5125	8		RESISTOR 5.1K 5% .25W FC TC=-400/+700	01121	CB5125
A28R48	0683-5125	8		RESISTOR 5.1K 5% .25W FC TC=-400/+700	01121	CB5125
A28R49	0683-5125	8		RESISTOR 5.1K 5% .25W FC TC=-400/+700	01121	CB5125
A28R50	0683-5125	8		RESISTOR 5.1K 5% .25W FC TC=-400/+700	01121	CB5125
A28R51	0757-0924	2		RESISTOR 1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-1001-G
A28U1	1820-0367	3		IC SHF-RGTR TTL R=8 PRL-IN PRL-OUT 4-BIT	01295	SN7495AN
A28U2	1820-0471	0		IC INV TTL HEX 1-INP	01295	SN7406N
A28U3	1820-0471	0		IC INV TTL HEX 1-INP	01295	SN7406N
A28U4	1820-0788	2		IC FF TTL D-TYRE POS-EDGE-TRIG CLEAR HEX	01295	SN74174N
A28U5	1820-0788	2		IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR HEX	01295	SN74174N
A28U6	1820-0367	3		IC SHF-RGTR TTL R=8 PRL-IN PRL-OUT 4-BIT	01295	SN7495AN
A28U7	1820-0903	3	2	IC SHF-RGTR TTL L R=8 SERIAL-IN PRL-OUT	01295	SN74L164N
A28U8	1820-0903	3		IC SHF-RGTR TTL L R=8 SERIAL-IN PRL-OUT	01295	SN74L164N
A29				SAME AS A28, USE PREFIX A29		
A30	05045-60019	6	1	BOARD ASSEMBLY, SOCKET (SERIES 1520)	28480	05045-60019
A30C1	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A30C2	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A30C3	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A30C4	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A30C5	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A30C6	0160-3877	5		CARACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A30C7	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A30C8	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A30C9	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A30C10	0160-3877	5		CARACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A30C11	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A30C12	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A30C13	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A30C14	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A30C15	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A30C16	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A30C17	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A30C18	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A30C19	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A30C20	0160-3877	5		CARACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A30C21	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A30C22	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A30C23	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A30C24	0160-3877	5		CAPACITOR-FXD 100RF +-20% 200VDC CER	28480	0160-3877
A30C25	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A30C26	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A30C27	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A30C28	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-1. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A30J1	1200-0610	5	1	SOCKET IC-TS 24-CONT (BASE) DIP SLDR	28480	1200-0610
	1200-0850	5	1	SOCKET, TEST 24-PIN	28480	1200-0850
A30K1	0490-1079	4		RELAY-REED 1A 500MA 100VDC 5VDC-COIL	28480	0490-1079
A30K2	0490-1079	4		RELAY-REED 1A 500MA 100VDC 5VDC-COIL	28480	0490-1079
A30K3	0490-1079	4		RELAY-REED 1A 500MA 100VDC 5VDC-COIL	28480	0490-1079
A30K4	0490-1079	4		RELAY-REED 1A 500MA 100VDC 5VDC-COIL	28480	0490-1079
A30K5	0490-1079	4		RELAY-REED 1A 500MA 100VDC 5VDC-COIL	28480	0490-1079
A30K6	0490-1079	4		RELAY-REED 1A 500MA 100VDC 5VDC-COIL	28480	0490-1079
A30K7	0490-1079	4		RELAY-REED 1A 500MA 100VDC 5VDC-COIL	28480	0490-1079
A30K8	0490-1079	4		RELAY-REED 1A 500MA 100VDC 5VDC-COIL	28480	0490-1079
A30K9	0490-1079	4		RELAY-REED 1A 500MA 100VDC 5VDC-COIL	28480	0490-1079
A30K10	0490-1079	4		RELAY-REED 1A 500MA 100VDC 5VDC-COIL	28480	0490-1079
A30K11	0490-1079	4		RELAY-REED 1A 500MA 100VDC 5VDC-COIL	28480	0490-1079
A30K12	0490-1079	4		RELAY-REED 1A 500MA 100VDC 5VDC-COIL	28480	0490-1079
A30L1	9100-1791	1		COIL 290NH 20% .230X.375LG-NOM	28480	9100-1791
A30L2	9100-1791	1		COIL 290NH 20% .230X.375LG-NOM	28480	9100-1791
A30L3	9100-1791	1		COIL 290NH 20% .230X.375LG-NOM	28480	9100-1791
A30L4	9100-1791	1		COIL 290NH 20% .230X.375LG-NOM	28480	9100-1791
A30L5	9100-1791	1		COIL 290NH 20% .230X.375LG-NOM	28480	9100-1791
A30L6	9100-1791	1		COIL 290NH 20% .230X.375LG-NOM	28480	9100-1791
A30L7	9100-1791	1		COIL 290NH 20% .230X.375LG-NOM	28480	9100-1791
A30L8	9100-1791	1		COIL 290NH 20% .230X.375LG-NOM	28480	9100-1791
A30L9	9100-1791	1		COIL 290NH 20% .230X.375LG-NOM	28480	9100-1791
A30L10	9100-1791	1		COIL 290NH 20% .230X.375LG-NOM	28480	9100-1791
A30L11	9100-1791	1		COIL 290NH 20% .230X.375LG-NOM	28480	9100-1791
A30L12	9100-1791	1		COIL 290NH 20% .230X.375LG-NOM	28480	9100-1791
A30L13	9100-1791	1		COIL 290NH 20% .230X.375LG-NOM	28480	9100-1791
A30L14	9100-1791	1		COIL 290NH 20% .230X.375LG-NOM	28480	9100-1791
A30L15	9100-1791	1		COIL 290NH 20% .230X.375LG-NOM	28480	9100-1791
A30L16	9100-1791	1		COIL 290NH 20% .230X.375LG-NOM	28480	9100-1791
A30L17	9100-1791	1		COIL 290NH 20% .230X.375LG-NOM	28480	9100-1791
A30L18	9100-1791	1		COIL 290NH 20% .230X.375LG-NOM	28480	9100-1791
A30L19	9100-1791	1		COIL 290NH 20% .230X.375LG-NOM	28480	9100-1791
A30L20	9100-1791	1		COIL 290NH 20% .230X.375LG-NOM	28480	9100-1791
A30L21	9100-1791	1		COIL 290NH 20% .230X.375LG-NOM	28480	9100-1791
A30L22	9100-1791	1		COIL 290NH 20% .230X.375LG-NOM	28480	9100-1791
A30L23	9100-1791	1		COIL 290NH 20% .230X.375LG-NOM	28480	9100-1791
A30L24	9100-1791	1		COIL 290NH 20% .230X.375LG-NOM	28480	9100-1791
A30R1	0698-8369	9		RESISTOR 2.7 5% .125W CC TC=-120/+400	01121	BB27G5
A30R2	0698-8369	9		RESISTOR 2.7 5% .125W CC TC=-120/+400	01121	BB27G5
A30R3	0698-8369	9		RESISTOR 2.7 5% .125W CC TC=-120/+400	01121	BB27G5
A30TP1	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A30TP2	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A30TP3	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A30TP4	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A30TP5	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A30TP6	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A30TP7	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A30TP8	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A30TP9	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A30TP10	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A30TP11	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A30TP12	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A30TP13	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A30TP14	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A30TP15	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A30TP16	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A30TP17	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A30TP18	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A30TP19	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A30TP20	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A30TP21	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A30TP22	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A30TP23	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A30TP24	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A30TP25	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
	0380-0785	6	4	STANDOFF-RVT-ON .187-IN-LG 6-32THD	00000	ORDER BY DESCRIPTION

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-1. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A31	05045-60020	9	1	BOARD ASSEMBLY, TEST HD INT	28480	05045-60020
A31XA28	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A31XA29	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A31XA30A	1251-0472	4	1	CONNECTOR-PC EDGE 6-CONT/ROW 2-ROWS	28480	1251-0472
A32	05045-60016	3	1	BOARD ASSEMBLY, MOTHER INTERFACE	28480	05045-60016
A32C1	0180-0160	5	1	CAPACITOR-FXD 22UF+-20% 35VDC TA	56289	150D226X0035M2
A32R1	0757-0941	3		RESISTOR 5.1K 2% .125W F TC=0+-100	24546	C4-1/8-T0-5101-G
A32XA25	1251-2035	9	1	CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A32XA26	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A33	05045-60014	1	1	BOARD ASSEMBLY, MAIN MOTHER (SERIES 1628)	28480	05045-60014
A33C1	0180-0161	6		CAPACITOR-FXD 3.3UF+-10% 35VDC TA	00908	T110B335K035AS
A33C2	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A33C3	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A33C4	0180-0161	6		CAPACITOR-FXD 3.3UF+-10% 35VDC TA	00908	T110B335K035AS
A33C5	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A33C6	0180-0161	6		CAPACITOR-FXD 3.3UF+-10% 35VDC TA	00908	T110B335K035AS
A33C7	0180-0161	6		CAPACITOR-FXD 3.3UF+-10% 35VDC TA	00908	T110B335K035AS
A33C8	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A33C9	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A33C10	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A33C11	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A33C12	0180-0161	6		CAPACITOR-FXD 3.3UF+-10% 35VDC TA	00908	T110B335K035AS
A33C13	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A33C14	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A33C15	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A33C16	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A33C17	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A33R1	0757-0346	2	1	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A33XA4	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A33XA5	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A33XA6	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A33XA7	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A33XA8	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A33XA9	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A33XA10	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A33XA11	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A33XA12	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A33XA13	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A33XA14	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A33XA15	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A33XA16	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A33XA17	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A33XA18	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A33XA19	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A33XA20	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A33XA21	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A33XA22	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A33XA23	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A33XA24	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
	1251-1115	4	15	POLARIZING KEY-PC EDGE CONN	28480	1251-1115
A34	05150-60011	6	1	PRINTER MECHANICAL ASSEMBLY	28480	05150-60011
A34A1	5080-9051	4	1	PRINT HEAD	28480	5080-9051
A34L1	9100-3515	1	1	PAPER ADV COIL	28480	9100-3515
A35	09810-67962	7	1	SENSOR ASSEMBLY(ORDERED AS PART OF A25)	28480	09810-67962
A35CR1000	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A350A11	2140-0092	0	4	LAMP-INCAND 665 5VDC 60MA T-1-BULB	0000J	665 TIP END
A350A21	2140-0092	0		LAMP-INCAND 665 5VDC 60MA T-1-BULB	0000J	665 TIP END
A350A31	2140-0092	0		LAMP-INCAND 665 5VDC 60MA T-1-BULB	0000J	665 TIP END
A350A41	2140-0092	0		LAMP-INCAND 665 5VDC 60MA T-1-BULB	0000J	665 TIP END

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-1. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A35M1	09820-29761	6	1	MOTOR ASSEMBLY	28480	09820-29761
A35Q10	1990-0306	9	4	PHOTOTRANSISTOR VAX=40V ID=100NA	28480	1990-0306
A35Q20	1990-0306	9		PHOTOTRANSISTOR VAX=40V ID=100NA	28480	1990-0306
A35Q30	1990-0306	9		PHOTOTRANSISTOR VAX=40V ID=100NA	28480	1990-0306
A35Q40	1990-0306	9		PHOTOTRANSISTOR VAX=40V ID=100NA	28480	1990-0306
				MISCELLANEOUS PARTS		
	1450-0153	0	1	LAMPHOLDER MDGT-SC-FLG-SKT TUR-TERM	28480	1450-0153
	09810-23301	6	1	LAMP, RETAINER	28480	09810-23301
	09810-25701	4	1	NUT, RETAINING	28480	09810-25701
	09810-26564	9	1	PC BOARD, SENSOR MOUNTING	28480	09810-26564
A36	05045-60041	4	1	BOARD ASSEMBLY, ONE SHOT (SERIES 1748)	28480	05045-60041
A36C1	0160-3762	7	2	CAPACITOR-FXD .68UF +-5% 50VDC MET-POLYC	28480	0160-3762
A36C2	0160-3762	7		CAPACITOR-FXD .68UF +-5% 50VDC MET-POLYC	28480	0160-3762
A36J1	1200-0559	6	1	SOCKET-IC 20-CONT DIP DIP-SLDW (BASE)	28480	1200-0851
A36P1	1200-0557	9		SOCKET-IC 20-CONT DIP DIP-SLDW (BASE)	19613	220-0334-00-0602
A36P2	1251-4259	3	1	CONNECTOR-SGL CONT PIN .031-IN-BSC-SZ	28480	1251-4259
A36R1	0757-0449	6	2	RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
A36R2	0757-0449	6		RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
A36S1	3101-1860	1		SWITCH-SL 5-1A DIP-SLIDE-ASSY .1A 50VDC	28480	3101-1860
A36S2	3101-1841	8	3	SWITCH-SL 4-1A DIP-SLIDE-ASSY .1A 50VDC	28480	3101-1841
A36S3	3101-1841	8		SWITCH-SL 4-1A DIP-SLIDE-ASSY .1A 50VDC	28480	3101-1841
A36S4	3101-1841	8		SWITCH-SL 4-1A DIP-SLIDE-ASSY .1A 50VDC	28480	3101-1841
A37	05045-60043	6	1	STATIC PROTECTION BOARD (SERIES 1916)	28480	05045-60043
A37C1	0160-4557	0	2	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4557
A37C2	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4557
A37C3	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A37C4	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A37CR1-A37CR192	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A37P1	1251-2658	2	1	CONNECTOR-PC EDGE 50-CONT/ROW 2-ROWS	28480	1251-2658
A38	05045-60037	8	1	BOARD ASSEMBLY, HP-IB INTERFACE (SERIES 1712)	28480	05045-60037
A38CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A38J1	1200-0433	0	1	SOCKET-IC 24-CONT	28480	1200-0433
A38J3	1251-3283	1		CONNECTOR 24-PIN F MICRORIBBON	28480	1251-3283
A38R1	1810-0136	3	2	NETWORK-RES 10-PIN-SIP .1-PIN-SPCG	28480	1810-0136
A38R2	1810-0136	3		NETWORK-RES 10-PIN-SIP .1-PIN-SPCG	28480	1810-0136
				PRECISION RESISTOR PACK BOARD (05045-60042)		
	0698-6362	24		RESISTOR 1K 0.1% .125W		0698-6362
	1251-4364	2		CONNECTOR 12-PIN HEADER		1251-4364
	1400-0995	1		CABLE GRABBER		1400-0995

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-1. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				CHASSIS PARTS		
A1						
B1	3160-0287	8	2	FAN-TBAX 45-CFM 115V 50/60-HZ 1.5-THK	28480	3160-0287
B2	3160-0287	8		FAN-TBAX 45-CFM 115V 50/60-HZ 1.5-THK	28480	3160-0287
C1	0150-0119	1	1	CAPACITOR-FXD .01UF/.01UF +-20%	28480	0150-0119
C1	0180-2179	0	1	CAPACITOR-FXD 0600UF+75-10% 15VDC AL (PART OF J1)	00853	500482U015AA2A
C2	0180-0580	3	2	CAPACITOR-FXD .04F+75-10% 15VDC AL	56289	602D403G015HB2A
C3	0180-0580	3		CAPACITOR-FXD .04F+75-10% 15VDC AL	56289	602D403G015HB2A
C4	0180-2277	9	2	CAPACITOR-FXD 8200UF+75-10% 25VDC AL	56289	36D822G025AC2A
C5	0180-2277	9		CAPACITOR-FXD 8200UF+75-10% 25VDC AL	56289	36D822G025AC2A
C6	0180-0579	0	2	CAPACITOR-FXD 7200UF+75-10% 30VDC AL	00853	500722U030AD2A
C7	0180-0579	0		CAPACITOR-FXD 7200UF+75-10% 30VDC AL	00853	500722U030AD2A
C8	0180-0577	8	1	CAPACITOR-FXD .028F+75-10% 40VDC AL	00853	500283U040CB2A
C9	0160-3094	8	9	CAPACITOR-FXD .1UF +-10% 100VDC CER	28480	0160-3094
C10	0160-3094	8		CAPACITOR-FXD .1UF +-10% 100VDC CER	28480	0160-3094
C11	0160-3094	8		CAPACITOR-FXD .1UF +-10% 100VDC CER	28480	0160-3094
C12	0160-3094	8		CAPACITOR-FXD .1UF +-10% 100VDC CER	28480	0160-3094
C13	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
CR1	1906-0058	1	1	DIODE-FW BRDG 100V 30A VF DIFF=1.1MV	04713	MDA990-2
CR2	1902-0986	6	2	DIODE-ZNR 9.1V 5% PD=1W IR=1UA	04713	1N5632AP1
CR3	1902-0986	6		DIODE-ZNR 9.1V 5% PD=1W IR=1UA	04713	1N5632AP1
DS1	2140-0025	9	5	LAMP-INCAND 327 28VDC 40MA T-1-3/4-BULB	28480	2140-0025
DS2	2140-0025	9		LAMP-INCAND 327 28VDC 40MA T-1-3/4-BULB	28480	2140-0025
DS3	2140-0025	9		LAMP-INCAND 327 28VDC 40MA T-1-3/4-BULB	28480	2140-0025
DS4	2140-0025	9		LAMP-INCAND 327 28VDC 40MA T-1-3/4-BULB	28480	2140-0025
DS5	2140-0025	9		LAMP-INCAND 327 28VDC 40MA T-1-3/4-BULB	28480	2140-0025
F1	2110-0381	7	1	FUSE 3A 250V SLO-BLO 1.25X.25 UL (PART OF J1)	28480	2110-0381
F1	2110-0304	4	1	FUSE 1.5A 250V SLO-BLO 1.25X.25 UL (PART OF J1)	28480	2110-0304
F2	2110-0054	1	2	FUSE 15A 250V MDM-BLO 1.25X.25 UL	28480	2110-0054
F3	2110-0054	1		FUSE 15A 250V MDM-BLO 1.25X.25 UL	28480	2110-0054
J1	0960-0444	2	1	POWER MODULE, UNFILTERED	28480	0960-0444
L1	9140-0136	0	2	COIL-MLD 22UH 10% Q=50 .261DX.938LG-NOM (PART OF J1)	28480	9140-0136
L2	9140-0136	0		COIL-MLD 22UH 10% Q=50 .261DX.938LG-NOM (PART OF J1)	28480	9140-0136
MP1	5040-7219	8	2	STRAP, HANDLE, CAP-FRONT	28480	5040-7219
MP2	5040-7220	1	2	STRAP, HANDLE, CAP-REAR	28480	5040-7220
MP3	5060-9805	4	2		28480	5060-9805
MP4	05045-00023	6	2	COVER, SIDE	28480	05045-00023
MP5	5040-7201	8	4	FOOT(STANDARD)	28480	5040-7201
MP6	5001-0440	1	1	TRIM, SIDE	28480	5001-0440
MP7	5040-7202	9	1	TRIM, TOP	28480	5040-7202
MP8	5060-9848	5	1		28480	5060-9848
MP9	5060-9836	1	1		28480	5060-9836
MP10	05045-20201	4	1	PANEL, FRONT EXTRACTOR	28480	05045-20201
MP11	3131-0367	4	1	CAP, SWITCH, LOAD	28480	3131-0367
MP12	3131-0369	6	1	CAP, SWITCH, PASS	28480	3131-0369
MP13	3131-0370	9	1	CAP, SWITCH, CONT	28480	3131-0370
MP14	3131-0371	0	1	CAP, SWITCH, FAIL	28480	3131-0371
MP15	3131-0368	5	1	CAP, SWITCH, TEST	28480	3131-0368
MP16	05045-00016	7	1	SUB-PANEL, CONTROLS	28480	05045-00016
MP17	05045-60112	0	1	DOOR ASSY, PRINTER	28480	05045-60112
MP18	05045-20205	8	1	PIN, HINGE C.D.	28480	05045-20205
MP19	05045-60111	9	1	DOOR ASSY, CONTROL	28480	05045-60111
MP20	05045-20206	9	1	PIN, HINGE, P.D.	28480	05045-20206
MP21	05045-20203	6	1	AXLE, PAPER ROLL	28480	05045-20203
MP23				NOT ASSIGNED		
MP24	05045-40003	6	1	COVER, TEST HEAD	28480	05045-40003
MP25				NOT ASSIGNED		
MP26				NOT ASSIGNED		
MP27	05045-20204	7	2	SCREW, TONGUE	28480	05045-20204
MP28	05045-00027	0	1	GUIDE, BOARD, SOCKET DRIVE	28480	05045-00027
MP29	05045-00021	4	1	TRAY, TEST HEAD	28480	05045-00021
MP31	05045-40001	4	1	GUIDE, MAG CARD, BOTTOM	28480	05045-40001
MP32	05045-40002	5	1	GUIDE, MAG, CARD, TOP	28480	05045-40002
MP33	0403-0150	7	6	GUIDE-PC BD GRA POLYC .062-BD-THKNS	28480	0403-0150
MP34	05045-00004	3	1	COVER, POWER SUPPLY	28480	05045-00004
MP35	5020-8805	8	1	FRAME, FRONT	28480	5020-8805
MP36	05045-00014	5	1	SUPPORT, CARD READER	28480	05045-00014
MP37	05045-00015	6	1	BRACKET, CARD READER	28480	05045-00015

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-1. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
	05045-00013	4	1	SUPPORT, INTERFACE M.B.	28480	05045-00013
MP38	05045-00010	1	2	GIDDE, BOARD, LEFT	28480	05045-00010
MP39	05045-00011	2	1	GUIDE, BOARD, RIGHT	28480	05045-00011
MP40	05045-00008	7	1	BULKHEAD, FRONT	28480	05045-00008
MP41	5020-8838	7	4		28480	5020-8838
MP42						
	05045-00009	8	1	STIFFENER, BLOCK HEAD	28480	05045-00009
MP43	05045-00007	6	1	BULKHEAD, REAR	28480	05045-00007
MP44	05045-00005	4	1	GUIDE, BOARD, FRONT, P.S.	28480	05045-00005
MP45	05045-00006	5	1	GUIDE, BOARD, REAR, P.S.	28480	05045-00006
MP46	5020-8806	9	1	FRAME, REAR	28480	5020-8806
MP47						
	05045-00029	2	1	SUPPORT, R.S. COVER	28480	05045-00029
MP48	9281-0401	0	1	PAPER, ROLL	28480	9281-0401
MP49	05045-00012	3	3	BRACKET, MOTHER BD	28480	05045-00012
MP50						
	1854-0671	3		TRANSISTOR NPN 2N6282 SI TO-3 PD=160W	04713	2N6282
Q1	1854-0671	3		TRANSISTOR NPN 2N6282 SI TO-3 PD=160W	04713	2N6282
Q2						
	0811-2640	9	1	RESISTOR 220 1% 3W PW TC=0+-20	28480	0811-2640
R1						
	9100-3044	1	1	TRANSFORMER-POWER PRI: 115/230V; 47/100V	28480	9100-3044
T1						
	05045-60106	2	1	CABLE ASSY, MAIN MOTHER	28480	05045-60106
W1	05045-60105	1	1	CABLE ASSY, BM TO BM	28480	05045-60105
W2	05045-60103	9	1	CABLE ASSY, FRONT PANEL CONTROL	28480	05045-60103
W3	05045-60104	0	1	CABLE ASSY, LM HANDLR	28480	05045-60104
W4	05045-60102	8	1	CABLE ASSY, TRANSFORMER	28480	05045-60102
W5						
	05045-60101	7	1	CABLE ASSY, AC POWER MODULE	28480	05045-60101
W6	8120-1378	1	1	CABLE ASSY 18AWG 3-CNDCT JGK-JKT	28480	8120-1378
W7						
				MISCELLANEOUS PARTS		
	0180-0078	4	2	CLAMP-CAP 2.062-DIA STL	56289	4586-28
	0340-0486	8	2	INSULATOR-COVER NYLON	28480	0340-0486
	0340-0596	1	1	INSULATOR-XSTR SIL-RBR	28480	0340-0596
	0360-0621	5	16	TERMINAL-SLDR LUG LK-MTG FOR-#10-SCR	79963	505-.196
	0380-0009	5	2	SPACER-RND .562-IN-LG .18-IN-ID	00000	ORDER BY DESCRIPTION
					00000	ORDER BY DESCRIPTION
	0380-0342	9	7	STANDOFF-RVT-DN .125-IN-LG 6-32THD	28480	0510-0182
	0510-0182	2	2	FASTENER-LATCH ADJ PANL GRIP RANGE	00000	ORDER BY DESCRIPTION
	0590-1116	2	4	NUT-8HMET-U-TR 6-40-THD .25-WD SPR-STL	28480	0900-0017
	0900-0017	9	2	O-RING .206-IN-ID .07-IN-XSECT-DIA NTRL	28480	1200-0456
	1200-0456	7	2	SOCKET-XSTR 2-CONT TO-3		
	1200-0559			SOCKET TEST 20-PIN	28480	1205-0293
	1205-0293	0	1	HEAT SINK TO-3-PKG	19613	220-0334-00-0802
	1200-0557	9	2	SOCKET, IC 20-CONT DIP TEST 20-PIN (BASE)		
				(PART OF SOCKET ADAPTER)	28480	1210-0013
				CLAMP-CAR 1.375-DIA STL	28480	1251-0159
	1210-0013	3	5	CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS		
	1251-0159	4	3		28480	1251-1115
				POLARIZING KEY-RC EDGE CONN	28480	1400-0008
	1251-1115	4	2	FUSEHOLDER-BLOCK 15A 250V 1-FU	28480	1400-0598
	1400-0008	9	1	CLAMP-CAP 2.5-DIA STL	28480	2680-0172
	1400-0598	2	4	SCREW-MACH 10-32 .375-IN-LG 100 DEG	28480	3101-1671
	2680-0172	1	2	CAP-PUSHBUTTON BLACK; .375-IN DIA		
	3101-1671	2			00000	080
			1	FOAM STRIP, 1/4 X 2"	28480	7120-1254
	4208-0098	2	1	NAMEPLATE .312-IN-WD .50-IN-LG AL	28480	7120-4289
	7120-1254	1	1	LABEL-INFORMATION 1.32-IN-WD 1.6-IN-LG	28480	7122-0097
	7120-4289	8	1	PLATE-SERIAL .5-IN-WD 1.25-IN-LG AL	28480	8660-0463
	7122-0097	2	1			
	8660-0463	7	1		28480	05035-40004
				FOOT	28480	05045-00002
	05035-40004	5	4	PANEL, REAR	28480	05045-00003
	05045-00002	1	1	PAN, FLOOR	28480	05045-00022
	05045-00003	2	1	COVER, BOTTOM INSULATOR	28480	05045-00024
	05045-00022	5	1	COVER, RECEPTACLE		
	05045-00024	7	1		28480	05045-00038
				SHIELD, PROCESSOR	28480	05045-60015
	05045-00038	1	1	BOARD ASSEMBLY, PR/ROR INT	28480	05045-60019
	05045-60015	2	2	DUMMY IC, 16-PIN	28480	05045-60032
	05045-60019	8	1	SOCKET ADAPTER 20-PIN 300 MILCENTERS	28480	05045-60042
	05045-60032	3	1	R-PACK PRECISION RESISTOR	28480	05045-60120
	05045-60042	5	1	DIAGNOSTIC CARD KIT		
	05045-60120	0	1		28480	05045-80020
				DUMMY IC, 24-PIN	28480	05045-00037
	05045-80020	1	1	CLIP, PAPER RETURN		
	05045-00037	2	1			

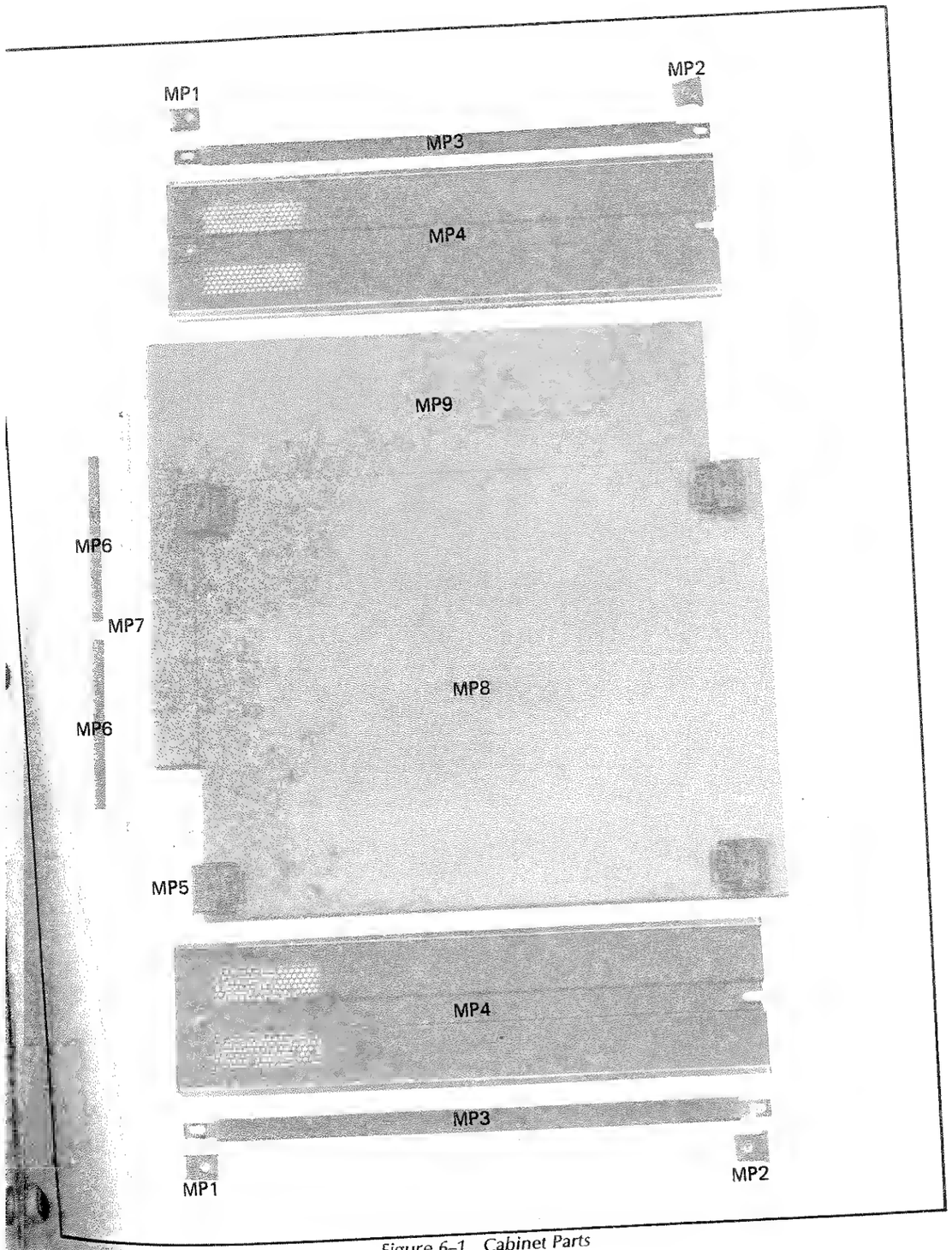


Figure 6–1. Cabinet Parts

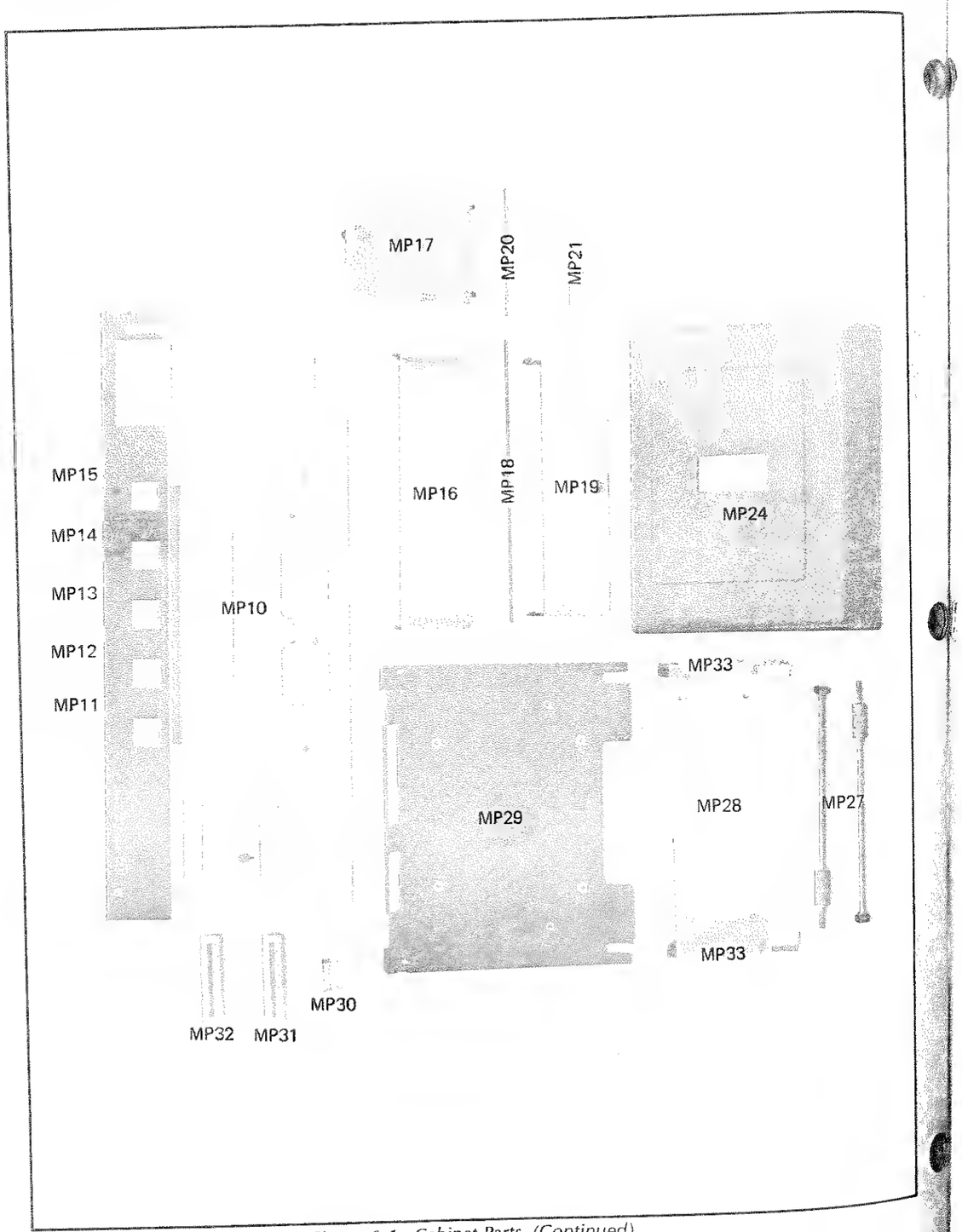
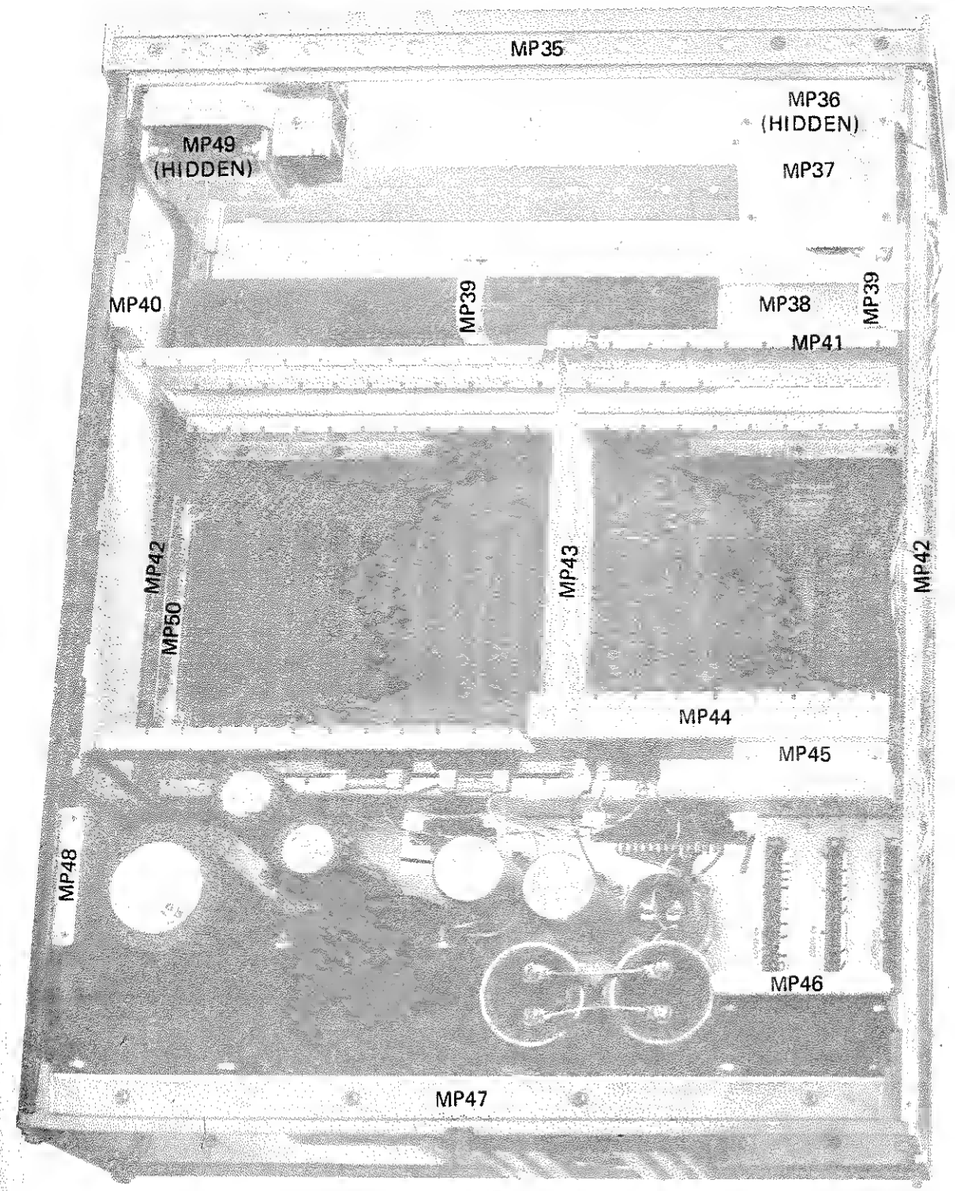


Figure 6-1. Cabinet Parts (Continued)



MP34
POWER SUPPLY COVER
(NOT SHOWN)

Figure 6-1. Cabinet Parts (Continued)

Table 6-2. Manufacturers Code List

Mfr No.	Manufacturer Name	Address	Zip Code
0000J	GTE Sylvania Miniature LT Prod	Hillsboro, NH	03244
00000	Any Satisfactory Supplier		
00853	Sangamo Elec Co S. Carolina Div	Pickens, SC	29671
0090B	Kemet		
01121	Allen-Bradley Co	Milwaukee, WI	53204
01295	Texas Instr Inc Semicond Cmpnt Div	Dallas, TX	75222
0192B	RCA Corp Solid State Div	Somerville, NJ	08876
04713	Motorola Semiconductor Products	Phoenix, AZ	85062
07263	Fairchild Semiconductor Div	Mountain View, CA	94042
19613	Textool Products Inc	Irving, TX	75060
24546	Corning Glass Works (Bradford)	Bradford, PA	16701
27014	National Semiconductor Corp	Santa Clara, CA	95051
28480	Hewlett-Packard Co Corporte HQ	Palo Alto, CA	94304
30161	Aavid Engineering Inc	Laconia, NH	03246
30983	Mepco/Electra Corp	San Diego, CA	92121
52072	Circuit Assembly Corp	Costa Mesa, CA	92626
56289	Sprague Electric Co	North Adams, MA	01247
71590	Centralab Elek Div Globe-Union Inc	Milwaukee, WI	50501
72136	Electro Motive Corp Sub IEC	Willimantic, CT	06226
73138	Beckman Instruments Inc Helipot Div	Fullerton, CA	92634
79963	Zierick Mfg Co	Mt Kisco, NY	10549
84411	TRW Capacitors Div	Ogallala, NE	69153
91637	Dale Electronics Inc	Columbus, NE	68601

SECTION VII
MANUAL CHANGES

7-1. INTRODUCTION

7-2. This section contains information necessary to adapt this manual to older instruments. This manual applies directly to 5045A instruments having serial prefix 1932A.

7-3. NEWER INSTRUMENTS

7-4. As changes are made, newer instruments may have a serial prefix not listed in this manual. Manuals for these instruments are supplied with a manual change sheet, containing the required information. Contact the nearest Hewlett-Packard Sales and Service Office for information if this sheet is missing.

7-5. OLDER INSTRUMENTS

7-6. To adapt this manual to instruments having a serial prefix prior to 1932A, perform the backdating that applies to your instrument's serial prefix as listed in Table 7-1 below.

Table 7-1. Manual Backdating

If Your Instrument has Serial or Serial Number Below	Make the Following Changes to Your Manual
1916	1
1852	1,2
1712A	1,2,3
1704A	1,2,3,4
1628A176 thru 185	1,2,3,4,5
1628A156 thru 175	1,2,3,4,5,6
1620A	1,2,3,4,5,6,7
1520A	1,2,3,4,5,6,7,8

CHANGE 1

Page 6-23, Table 6-1, A28 Replaceable Parts:
Change A28 from Series 1916 to 1520A.

Page 8-147, Figure 8-31, A28 Schematic Diagram:
Change A28 Series from 1916 to 1516 and 1520.

Delete a connection between the shell and pin 17 (circuit common) of 24-pin dual inline connector P2 and connection between shell and pin 36 (circuit common) of 50-pin dual inline connector P4.

Page 6-15, Table 6-1, A13 (05045-60013) Replaceable Parts:
Change A13 Series from 1916 to 1712.
Change HP Part Numbers for A13U16, 17, 25 and U26 from 1820-1938 to 1820-1614.

Page 8-135, Figure 8-27 (Sheet 1 of 2), A13-A24 Schematic Diagram:
Change A13-A24 from Series 1916 to 1712.

Page 6-29, Table 6-1, Replaceable Parts:
Delete CR3 1902-0986.

Page 8-113, Figure 8-17, A2 Schematic Diagram:
Delete 9.1V breakdown diode (CR3) between terminal $\overline{15}$ and terminals 11, $\overline{11}$.

Page 6-29, Replaceable Parts:
Delete complete A37 parts list.

SECTION VIII
MAINTENANCE AND TROUBLESHOOTING

8-1. INTRODUCTION

8-2. This section contains maintenance, troubleshooting, theory of operation, component locators and schematic diagrams. The maintenance information includes a table for identification of assemblies and a table of test equipment required. Removal and disassembly procedures, in addition to repair and cleaning procedures, are included. Troubleshooting covers the CPU, the pin drivers and self check. A troubleshooting flow chart, and operation flow chart and a ROM listing are included.

8-3. ASSEMBLY IDENTIFICATION

8-4. Table 8-1 lists the designations, name and Hewlett-Packard part number of the assemblies that comprise the 5045A.

Table 8-1. Assembly Identification

Assembly	Description	HP Part No.
A1	±15V and ±18V Regulator	05045-60001
A2	±8V and ±12V Regulator	05045-60002
A3	±5V and +18V Regulator	05045-60003
A4	Arithmetic Logic Unit	05045-60004
A5	Processor Memory	05045-60005
A6	Main Memory	05045-60006
A7	I/O Board (HP-IB)	05045-60007
A8	ROM	05045-60008
A9	Address	05045-60009
A10	D/A Control	05045-60010
A11	Reference Level Generator	05045-60011
A12	Pin Driver Control	05045-60012
A13 thru A24	Pin Driver	05045-60013
	(A17 thru A20 comprise Option 024)	
A25	Card Reader Interface Assembly	09810-66562
A26	Card Reader/Printer Interface	05045-60015
A27	Front Panel Switch Board	05045-60021
A28 or A29	Socket Driver	05045-60017
A30	Socket Assembly	05045-60019
A31	Test Head Interconnect	05045-60020
A32	Interface Motherboard	05045-60016
A33	Main Motherboard	05045-60014
A34	Thermal Printer	05150-60011
A35	Magnetic Card Reader	09810-67962
A36	One-Shot Multivibrator	05045-60041
A37	Static Protection	05045-60043
A38	HP-IB Interface	05045-60037

8-17. Card Reader Removal

a. Disconnect power from 5045A.

b. Remove top cover of 5045A by loosening screw on rear of cover.

c. Remove top trim strip using flat-blade screwdriver inserted into slots in strip to lift strip out.

d. Remove A25 Card Reader Interface board by lifting board up until it is out of connector, then push board down and to the rear of the connector until the left end of the board passes through the board guide. Pull left side of board forward, sliding the board under the guide. When clear of the guide lift the board up until the side edge connector can be removed. Remove the connector in the center of the board, making sure not to bend the pins. Remove board from instrument.

e. Turn 5045 on its side and remove bottom cover by loosening the screw at rear of cover.

f. Remove the screw second in from left end of the instrument on the front flange (bottom portion). (A nut on the inside of the instrument on this screw must be held to allow removal of the screw.)

g. Remove the two screws on the left top of the front flange. This will allow the card reader assembly to be removed.

h. Reverse the preceding procedure to reinstall the card reader assembly. The nut and screw attaching the lower bracket and lower front flange should be loosened and the lower portion of the card reader moved if the card does not feed smoothly into and out of the reader. The nut and screw should then be retightened.

8-18. Cleaning Solvents

8-19. Recommended freon cleaning solvents listed below can be used for the card driving wheels and the commutator contacts.

CAUTION

Do not use freon on Magnetic Read/Write head.

Manufacturer's Name	Manufacturer's Part No.	HP Part No.
Sprayon Products	#2002	8500-0232
Miller-Stephenson	MS-180	
Jesta	TFA 1135	
CRC Chemicals	2016	

CAUTION

Do not use solvents which are not recommended. Some solvents will leave a harmful residue which will seriously affect the operation of the card reader.

8-20. Cleaning the Card Driving Wheels

8-21. The magnetic card reader must be removed as described above. Remake the electrical circuit connections to the card reader and start the card reader running. Spray a moderate amount of solvent on a kimwipe and wipe the driving surface of the two drive wheels which are shown in Figure 8-1. Repeat this procedure until no more dirt can be removed from the drive wheels.

CAUTION

Do not spray solvent directly onto the drive wheels. Solvent will destroy adjacent plastic parts.

8-22. Cleaning the Motor Commutator Contacts

8-23. The magnetic card reader must be removed as described above. Loosen the two hex headed screws which fasten the end cap to the motor shown in Figure 8-1. Pull the end cap back to expose the commutator contacts. Remake the electrical circuit connections to the card reader and start the card reader running. Spray moderate amounts of solvent directly on the commutator contacts, until the motor runs smoothly at the normal speed. Do not wipe the commutator contacts with a cloth or tissue.

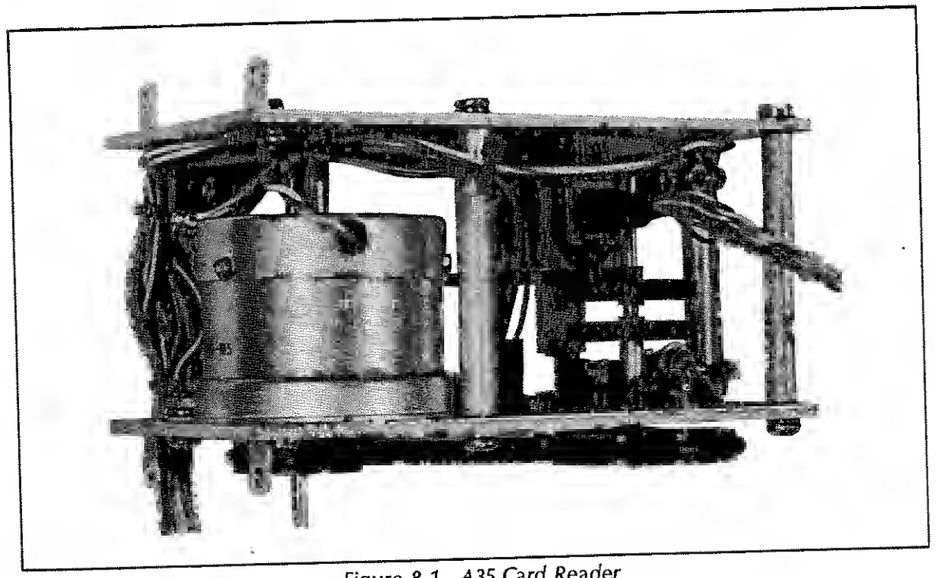


Figure 8-1. A35 Card Reader

8-24. Cleaning the Read/Write Head

8-25. Clean the card reader Read/Write head with cleaning card, HP Part Number 8660-0463. Instructions for use of this cleaning card are listed in the following paragraph. Cards are available from HP Customer Service Center, in Mountain View, California and Parts Center Europe, Boeblingen, Germany.

CAUTION

See warning on card.

8-26. Use of Cleaning Card for Magnetic Card Reader

8-27. This card should be used only as often as is necessary. Use when the reader gives erratic results, such as when loading a program card results in a "RELOAD" being printed by the thermal printer. It should also be used after approximately every 750 program card loadings or every 2 months, whichever comes first. If the reader continues to give erratic results after two passes of the cleaner card and these results are not restricted to a few cards, the problem may be in another part of the tester. Maintenance procedure for cleaning the card drive wheels (paragraph 8-20) should be performed if the card seems to be slipping.

8-28. Lamp Replacement

8-29. To replace a defective lamp in the card reader, proceed as follows:

a. Remove the card reader as described above.

b. Remove the lamp assembly by pulling it out with a pair of pliers.

c. Loosen brass nut on the front (Lamp) end of the assembly with a $^3/_{16}$" wrench. (See Figure 8-2.)

d. Remove the brass nut and lamp holder.

e. Replace the defective lamp, HP Part Number 2140-0092.

f. Screw the lamp holder back into place and replace the $^3/_{16}$" brass nut.

g. Press the lamp assembly into the assembly holder.

h. Check to assure that the magnetic card reader is performing properly by loading a known good program from a magnetic card into the tester and verify that the program in memory and the program on the card are identical.

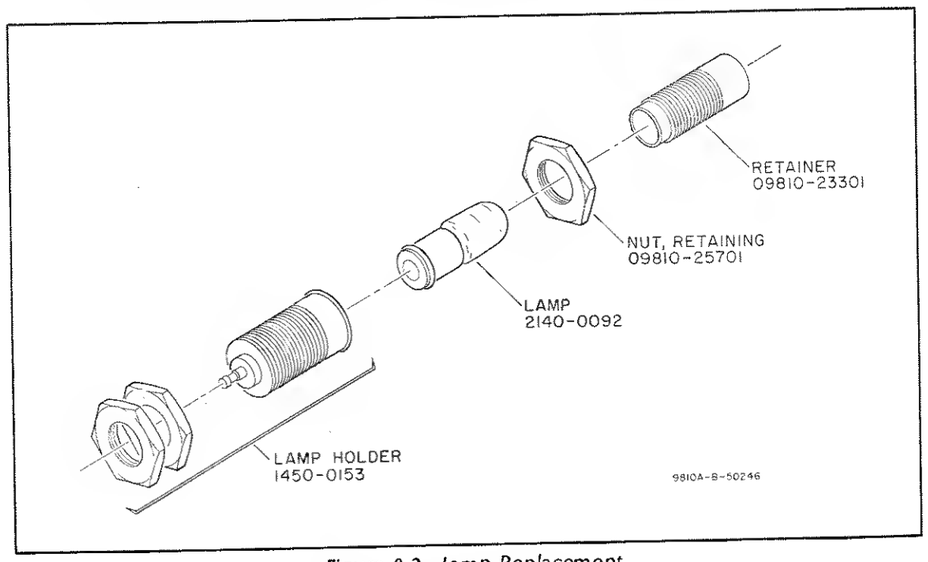


Figure 8-2. Lamp Replacement

8-30. If the card reader still malfunctions after performing the above cleaning and lamp replacement procedures, exchange it via your HP Service Office (listed at the rear of this manual).

8-31. There are two versions of magnetic card readers, as follows:

Version A:

This has a teflon guide on the motor shaft. The motor mounting nuts are the aircraft type with rubber inserts. The motor is purposefully left loose on its mounting bolts.

CAUTION

Do not tighten the motor mounting nuts. To do so will bind the motor shaft.

Version B:

This version does not have a teflon guide on the motor shaft. The motor mounting nuts have lock washers and hold the motor tight against its mounting surface.

CAUTION

Do not loosen the motor mounting nuts. To do so will cause the card reader to malfunction.

8-32. A34 THERMAL PRINTER MAINTENANCE

8-33. The following procedures are provided for maintenance of the thermal printer. To insure that the print head is not damaged by a possibly defective A26 Card Reader/Printer Interface board, the board should be checked per paragraph 8-40.

8-34. Printer Removal and Disassembly

8-35. Remove the printer as follows:

a. Disconnect gray cable and the red and blue wires from control board.

b. Remove A26 Card Reader/Printer Interface board.

c. Remove print mechanism by removing front casting top trim strip. Remove two top screws and mechanism will be loose and can be removed. Note that lower lip of paper guide overhangs the front panel and the upper paper guide is free to move and does not touch panel.

d. Remove mounting bracket by removing only the four screws on the rear of the assembly that hold the bracket to the side plates.

e. Remove the spring clip that holds the head in place by pressing down and sliding it towards the left side of the mechanism, then up and out.

f. Loosen the cam hold screws at rear of heat sink. Head and heat sink are ready to be removed. Note that there is a spring between the upper plastic paper guide and the heat sink. Remove heat sink by pressing the rear down and back.

8-36. PRINT HEAD REPLACEMENT. Remove the head from the heat sink by pressing a blunt tool through hole in the heat sink. There should be enough heat sink compound in heat sink to hold the new head in place. Install the new head in the heat sink.

8-37. ROLLER REPLACEMENT. Remove the thumbwheel. Then remove the right side plate only. Do not loosen any screws on the solenoid side of the mechanism other than the two on the mounting bracket. This will insure some mechanical alignment.

8-38. Remove the retaining ring holding the armature onto the shaft. Slide the armature/clutch assembly off the roller shaft. Slide the roller shaft out of the left side plate.

8-39. Install the new roller shaft and reassemble the mechanism. *Do not* oil the armature or side plate bearings. The right side plate should be adjsuted so that the bearing drag is minimized.

8-40. A26 Card Reader/Printer Interface Board Checkout

a. Check all power supplies. (Refer to paragraph 5-9.)

b. Load card in (card title should print), place AUTO/MAN switch to MAN.

c. Check current drawn by A26U5, U9, U13, U17 and U20 in the following manner:
Connect a 1/4 Watt 200 Ω resistor between +5 volts and:

U5 — pin 10,11,13,14,15

U9 — pin 10,11,13,14,15

U13 — pin 10,11,13,14,15

U17 — pin 10,11,13,14,15

U20 — pin 10,11,13,14,15

Measured voltage at each indicated pin should be less than 0.4V with load resistor applied.

d. Check the Group Enable lines (pins 19,33,16,32 of gray connector on the A26 board). Connect 1/2 Watt 200 Ω resistor from ground to each pin and measure voltage.

pin 19 — >+9.5V
pin 33 — >+9.5V
pin 16 — ~0V
pin 32 — ~0V

e. Check the voltage at U12A pins 4,5,6,7. Voltage should be greater than 2.4V.

f. Reinstall mechanism into the instrument and connect the gray cable, the red and blue wires to the A26 board. Mechanism should be positioned, using four screws on mounting bracket so that lip on lower paper guide rests on front panel and upper guide is free.

g. Check "Printer Group Enable Timing" per paragraph 5-12. Make adjustments as necessary.

h. Run "Printer Check" per paragraph 4-157.

i. Print spacing is controlled by an adjustable stop screw located between the solenoid and armature. The hex end is 3/16 inch. To reduce print spacing, turn the screw clockwise. To increase spacing, turn the screw counter-clockwise. Vertical spacing should be approximately 6 characters per inch.

j. Press STEP button to obtain a printout and repeat measurement and adjustment as necessary.

8-41. PC Boards Requiring Special Handling and Cleaning

8-42. The following PC boards require special handling and cleaning.

a. A11 Reference Level Generator, Part No. 05045-60011

b. A13-A24 Pin Driver, Part No. 05045-60013

c. A33 Main Motherboard, Part No. 05045-60014

d. A28 or A29 Scoket Driver, Part No. 05045-60017

e. A30 Socket Assembly, Part No. 05045-60019

f. A31 Test Head Interface, Part No. 05045-60020

CAUTION

The A11 DAC and A13 thru A24 pin driver boards contain CMOS circuits which are highly susceptible to static discharge damage. Handle these boards only by the large black heat sink or the board extractor.

8-43. HANDLING. The boards listed above should be handled only by the edges. Finger prints on the board surface may cause high resistance leakage and degrade instrument performance.

8-44. CLEANING. After repairs are made on the boards listed above, the contaminated areas should be washed with a special detergent such as Alcohol. The areas should be dried and sprayed with a coating (approximately 0.001 inch) of GE Dri-Film (or equivalent). Old film can be stripped from the board when necessary by using freon.

8-45. REPAIR

8-46. Printed Circuit Component Replacement

8-47. Component lead holes in the circuit boards have plated-through walls to ensure good electrical contact between conductors on opposite sides of the board. To prevent damage to the plating and the replacement component, apply heat sparingly, and work carefully.

8-48. Replacing Integrated Circuits

8-49. Following are two recommended methods of replacing integrated circuits:

a. SOLDER GOBBLER. This is the best method. Solder is removed from board by a soldering iron with a hollow tip connected to a vacuum source. **MUST NOT PRODUCE STATIC CHARGES WHEN OPERATING!**

b. CLIP-OUT. This method should be used as a last resort only. Clip the leads as close to the base as possible. With a soldering iron and long nose pliers, carefully remove the wires from each hole. Then clean the holes.

8-50. TROUBLESHOOTING

8-51. Troubleshooting the 5045A is divided into two sections: (1) the CPU and its peripherals, and (2) Pin Drivers and associated circuitry.

8-52. CPU troubleshooting covers the following circuits:

a. A35 Card Reader and interface
b. A34 Printer and interface
c. A4 Arithmetic Logic Unit (ALU)
d. A5 Processor Memory Board
e. A6 Main Memory Board
f. A8 ROM Board
g. A9 ROM Address Board

8-53. Pin Driver troubleshooting covers the following circuits:

a. A13-A24 Pin Drivers Boards
b. A28, A29 Socket Driver Boards (Fast Edge circuits)
c. A10 D/A and A12 Pin Driver Control Logic
d. A11 Reference Level Generators
e. A12 Pin Driver Control
f. A30 Socket Board
g. Relays

8-54. Troubleshooting the 5045A requires an understanding of the sequence of operation within the instrument. This sequence is divided into three levels of documentation: (1) general overall operations; (2) Firmware flow diagram; (3) ROM listing (mnemonic and hexcode).

8-55. The overall operational flow of information is as follows:

a. Power on.
b. Wait for LOAD button to be pressed.
c. Turn card reader and LOAD light on.
d. Read information from card.
e. Turn card reader motor and LOAD light off.
f. Perform checksum on data read in from card versus information stored on the card.
g. If checksum error, then print "RELOAD" and return to step b. If checksum is correct, print IC Type information.
h. Press TEST button (TEST light comes on).
i. Test Circuit (PASS, FAIL, or CONT light comes on).
j. Press LOAD button (go back to step c).
k. Press TEST (In MAN/HANDLR mode).
l. TEST light goes out.

8-56. Figure 8-4 is a troubleshooting flow diagram showing areas of concern when a particular step is not executed correctly. This is based on the use of the Self Check 1 & 2 Programs covered in paragraphs 4-13 and 4-14.

CAUTION

NEVER operate the 5045 with any of the Pin Driver boards (A13 to A24) installed while A10 or A11 or A12 are removed. It is all right to operate the 5045A with A13 to A24 removed if A10 or A11 or A12 are installed. A11 will not operate without A10 while A12 will operate independently of A10 and A11.

NOTE

Before proceeding further, perform clock adjustment per paragraph 5-11a.

8-57. CPU Troubleshooting

8-58. Check the symptoms listed and perform the appropriate procedure:

a. Instrument will not operate when LOAD button is pressed.
   1. Remove boards A10 through A24.
   2. Check power supplies per paragraph 5-9.
   3. Check clock per paragraph 5-11a.
   4. Check program flow in operational flow diagram, Figure 8-3.
   5. Connect 1601L and 10250A per Table 8-3 and perform the following steps.

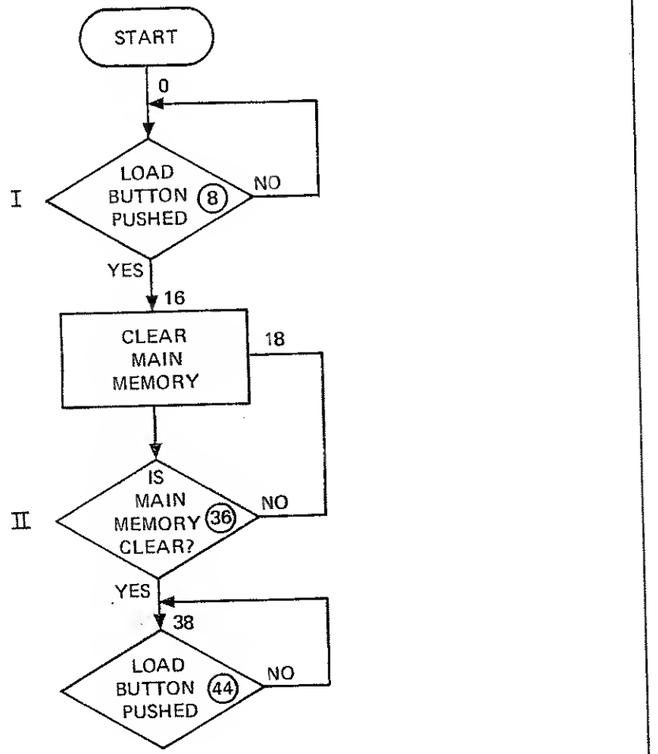


Figure 8-3. Operational Flow Diagram (First 44 Addresses)

Table 8-3. HP 1601L and HP 10250A Connections

Connect 1601L Data Inputs	To 5045A Test Points
0	A8TP1
1	A8TP2
2	A8TP3
3	A8TP4
4	A8TP5
5	A8TP6
6	A8TP7
7	A8TP8
8	A8TP9
9	A8TP10
10	Connect to 10250A output
11	A9TP3 (serial data)
Clock	A9TP1
GND	Chassis

Connect 10250A	To 5045A Test Points
1	A8TP11
2	A8TP12
3	A9TP6
4	A8TP13 (if 5045A is equipped with 05045-60030 connect to A9U2(12))
+5V	A5TP1
GND	Chassis

Trigger switch settings for 1601L and 10250A (Positive True Logic):

10250A:

1 & 2 per address to be checked

3 HI

4 HI

1601L:

0-9 per address to be checked

10 HI

11 OFF

LOGIC — PO5

DISPLAY MARK — ON

BYTE — 3 Bit (OCT)

CLOCK — ⎍

THRESHOLD — TTL

SAMPLE MODE — REPEAT

TRIGGER MODE — START DISPLAY

DELAY SET — ØØØØØ

Figure 8-4
TROUBLESHOOTING FLOW DIAGRAM

(See Page 8-13)

6. Set the 1601L and 10250A TRIGGER switches as follows:

   0-9 on 1601A and 1-2 on 10250A for Address 1. (All address related switches LO except 0 on 1601L to HI.)

7. Display should be as shown in Figure 8-6. (See explanation of how to read the ROM listing and flow diagrams, paragraph 8-71.)

8. Using the flow diagram and listing determine if the flow is correct. If not, determine where it starts to deviate.

NOTE

The basic operation of the CPU is best checked using the first 8 addresses. Check that this loop is correct before proceeding further. Boards included in this basic operation are the Power Supplies, A1, A2 and A3, A4 ALU, A5 Processor Memory, A6 Main Memory, A8 PROM and A9 Address, Front Panel.

b. Instrument operates properly until LOAD button is pressed.

1. Check the power supply while the unit is inoperative after LOAD button is pressed. If the power supplies are being loaded it is an indication that the pin driver boards may be loading the power supplies. Turn the power off and remove the pin driver boards. Repeat the test without pin driver boards. The instrument will operate without the pin drivers although failure will be registered.

2. Check that LOAD button data is being transfered from the A27 Front Panel board to A5U20 when the front panel transfer line is LOW as follows: sync scope of A27U11(1) (+ edge). On the first clock pulse (positive edge) after U11(1) goes high, a low should be shifted out, check that on A5U20(6) a high is also clocked out on the first clock pulse. Keep scope triggered on U11(1).

3. Check that the Main Memory is cleared *prior* to data loading by triggering on the Refresh line A6U27(5). Press the LOAD button but don't load the card. Check that the outputs of U36, U26, U19, U10, U8 and U17 are low for all 256 memory locations.

4. To check that the information is being loaded into the memory from the mag card, sync the scope on A6U20(3). Check that the data input at the following points A6U31(13 & 9) and check that U31 (1, 10) are alternately high. If there is no data at A6U31(9) the shift register may not be working properly.

5. Check that Data is also shifted out on A6($\overline{3}$) during the load operation.

6. Check that data is being shifted from the memories to the parallel/serial input shift register and back to the memory. Check all 24 outputs of U36, U26, U19, U10, U8 and U17.

7. Check the Main Memory to insure that the program is being stored. While waiting for the TEST button to be pressed the Main Memory should be periodically refreshed. Trigger scope off the Refresh line A6U27(5). Check that there is one Clock 2 for each of the two Ø clocks.

8. Use 1601L to check that the ROM address is cycling through addresses 464 to 584 prior to the TEST button being pressed. If not, check the CPU flow using the flow diagram.

9. Check that when A6(4) goes low, A6U28(5) also goes low. (This condition indicates that the ROM program has reached the logic model execution state and the main memory is the program source.) If in refresh mode, A26U28(5) will remain high until completion of refresh cycle.

8-59. Non-sequential Troubleshooting Hints for 5045A That Fails After TEST Button is Pressed.

8-60. With A12(4) shorted to the chassis all programs should be executed with no failure (except Self Check 1). This allows checking the Main Memory Program and ROM program flow. All controls should operate properly. In AUTO START mode the PASS and TEST lights should stay on or may flash. While in MAN START mode the tester should cycle once each time the TEST button is pressed. Pressing the TEST button while the program is being executed should stop execution and the TEST button light should turn off. If not, check the A21 Front Panel board and the ROM program flow.

8-61. To check the parameter storage on the A10 board, remove A11-A24 and load the Self Check 1 Card.

a. Set front panel switches as follows:

START — MAN/HANDLR
ON FAILURE — HOLD
V AND I RESULTS — ON
PRINTER — ON

The printout should be as follows (see page 8-17).

```
TEST:    1-1
FAIL       PASS       0
 1     -5LV   <-200 MA
 1    >7.5 V     -15LMA
 2     -5LV   <-200 MA
 2    >7.5 V     -15LMA
 3     -5LV   <-200 MA
 3    >7.5 V     -15LMA
 4     -5LV   <-200 MA
 4    >7.5 V     -15LMA
 5     -5LV   <-200 MA
 5    >7.5 V     -15LMA
 6     -5LV   <-200 MA
 6    >7.5 V     -15LMA
 7     -5LV   <-200 MA
 7    >7.5 V     -15LMA
 8     -5LV   <-200 MA
 8    >7.5 V     -15LMA
 9     -5LV   <-200 MA
 9    >7.5 V     -15LMA
10     -5LV   <-200 MA
10    >7.5 V     -15LMA
11     -5LV   <-200 MA
11    >7.5 V     -15LMA
12     -5LV   <-200 MA
13      5LV      10LMA
14      5LV      10LMA
15      5LV      10LMA
16      5LV      10LMA
17      5LV      10LMA
18      5LV      10LMA
19      5LV      10LMA
20      5LV      10LMA
21      5LV      10LMA
22      5LV      10LMA
23      5LV      10LMA
24      5LV      10LMA
CORRECT 111111111111
PIN
STATE 1>000000000000
FAIL PIN:   1    2    3
    4    5    6    7    8
    9   10   11   12

SELF CHECK 1
  CPU RDR PRNTR OK
```

```
TEST:    1-2
FAIL       PASS       0
 1     -5LV     -10LMA
 2     -5LV     -10LMA
 3     -5LV     -10LMA
 4     -5LV     -10LMA
 5     -5LV     -10LMA
 6     -5LV     -10LMA
 7     -5LV     -10LMA
 8     -5LV     -10LMA
 9     -5LV     -10LMA
10     -5LV     -10LMA
11     -5LV     -10LMA
12     -5LV     -10LMA
13      5LV    >200 MA
13 <-7.5 V      15LMA
14      5LV    >200 MA
14 <-7.5 V      15LMA
15      5LV    >200 MA
15 <-7.5 V      15LMA
16      5LV    >200 MA
16 <-7.5 V      15LMA
17      5LV    >200 MA
17 <-7.5 V      15LMA
18      5LV    >200 MA
18 <-7.5 V      15LMA
19      5LV    >200 MA
19 <-7.5 V      15LMA
20      5LV    >200 MA
20 <-7.5 V      15LMA
21      5LV    >200 MA
21 <-7.5 V      15LMA
22      5LV    >200 MA
22 <-7.5 V      15LMA
23      5LV    >200 MA
23 <-7.5 V      15LMA
24      5LV    >200 MA
24 <-7.5 V      15LMA
CORRECT 111111111111
PIN
STATE 1>000000000000
FAIL PIN:  13   14   15
   16   17   18   19   20
   21   22   23   24
```

b. If overall printout is incorrect, in format and/or wording, the problem is either in the printer interface or A8 ROM.

c. If limits are incorrect (i.e., 5LV, 10 LMA), problem is on A10 or A5, A6 boards. Check the A10 2K storage element and the output on A10(17) (serial data out to RAM). If limits are correct but non L values are incorrect then problem is in the A8 ROM (A11 and A12 must be installed and A12(4) shorted).

8-62. To check the A11 Reference Level Generator operation use V/I R-Pack Program Card. Figure 8-5 shows a typical waveform for A11TP1 triggered by A11U25(13).

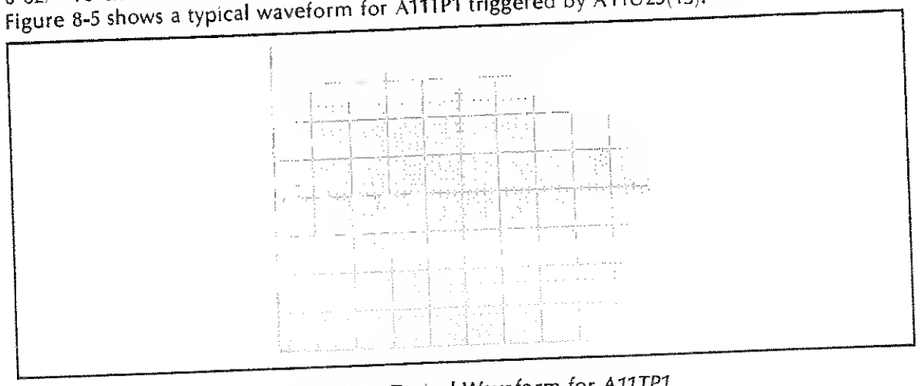


Figure 8-5. Typical Waveform for A11TP1

a. Check that the four reference output voltages at A11(11, 12, 13, 14) agree with the programmed voltages and currents as shown in Table 8-4, and current equations described in paragraph 8-131.

b. If the V and I printout is correct from the previous step but waveform or output voltages are incorrect, then the problem is on the A11 DAC converter or the A11 Sample and Hold circuit.

A11 Output	A13 Waveform
A11$\overline{(8)}$	A13TP1
A11(12)	A13U24(8)
A11(13)	A13U24(4)
A11(11)	A13U18(11)
A11(14)	A13U19(11)

c. Check that A11U25 outputs 15, 13, 12, 11, 2, 5, 4, 3 and 10 and U24 outputs 5, 7, 3, 10 are sequentially shifting a low pulse out.

8-63. Failure pin grouping may be used to troubleshoot as follows:

a. 1 or 2 adjacent pins failed means that pin driver or socket driver board is bad.

b. Failure of every fourth pin is seven pin groups starting with pin 1 on test socket means A12 board or one of the pin drivers in the group is bad.

c. If a group of four pins fail, then set 5045A front panel to:

START Auto
ON FAILURE — Continue
V/I RESULTS — OFF (down)
PRINTER — Off
Load "Self Check 2" card.

Then using an oscilloscope (this may require the use of a viewing hood) check for series of pulse at A12 U17 pins 2, 4, 6, 10, 12, 15.

8-64. Printer Problems

8-65. Check the symptoms listed and perform the appropriate procedure:

a. Paper advances but no printing.
   1. Check the A26 interface board group enable (paragraph 5-12).
   2. Check A26 character storage register clock.
   3. Check A26 print data register.

b. If printer prints but does not advance paper, check A26 paper advance circuit.

c. If overall printout format is incorrect but characters printed and spacing is correct, the problem is with the A8 ROM board.

d. If characters are not printed correctly but overall format spacing is correct, problem is on A26 board.

8-66. Card Reader Problems

8-67. Check the symptoms listed and perform the appropriate procedure:

a. LOAD button pushed and light comes on but reader motor does not come on.
   1. With instrument power off, remove A26 board from its socket and turn the power on. The reader motor should come on. If not, check A25 card reader interface and A35 card reader assembly.

b. With LOAD button pushed, LOAD light on, card runs through but "RELOAD" printed.
   1. Check for TTL data streams at A26U19(2,3,4), A26U1(13), U19(10,11,12) (while U19(6) is low) and U1(9).
   2. Use head cleaner card if the operation seems intermittent (paragraph 8-26).
   3. If activity is correct at above points the problem is associated with the A5 processor memory board.

8-68. Troubleshooting Using Flow Diagram and ROM Listing

8-69. Troubleshooting using flow diagram (Figure 8-4) and firmware (ROM) listing (paragraph 8-149) is performed as follows:

a. Connect 1601L/10250A per Table 8-3.

b. Set address of first decision point (i.e., address 8) and check that the instrument cycles through address 8 until the LOAD button is pressed.

c. Repeat step (b) using further check points designated by roman numerals on flow diagram. (Decimal numbers indicate ROM addresses.) When it is found that a check point has not been reached the previous check point should be checked and then the ROM listing used to step sequentially through the intervening program flow. Check that the program reaches each of the designated "GO TO" addresses until a deviation from normal flow is encountered. The test program may have to be reloaded several times to accomplish this isolation procedure. Turn power off then ON or momentarily ground A4(5) to regain control. Then use the normal card loading procedure to load the card.

8-70. Example of How to Interpret 1601L versus ROM Listing

8-71. Figure 8-6 shows the ROM addresses being incremented, starting at ROM address 1. Note that the address holds at address 5 for 12 clock cycles. This corresponds to the implementation of ROM Address 1-5 as shown in Figure 8-6. Figure 8-7 corresponds to the implementation of the last clock of Address 5 and address 6-9 and ending with address 0. This operation is shown in flow diagram, Figure 8-3.

8-72. The ROM Listings (paragraph 8-149) are read as follows:

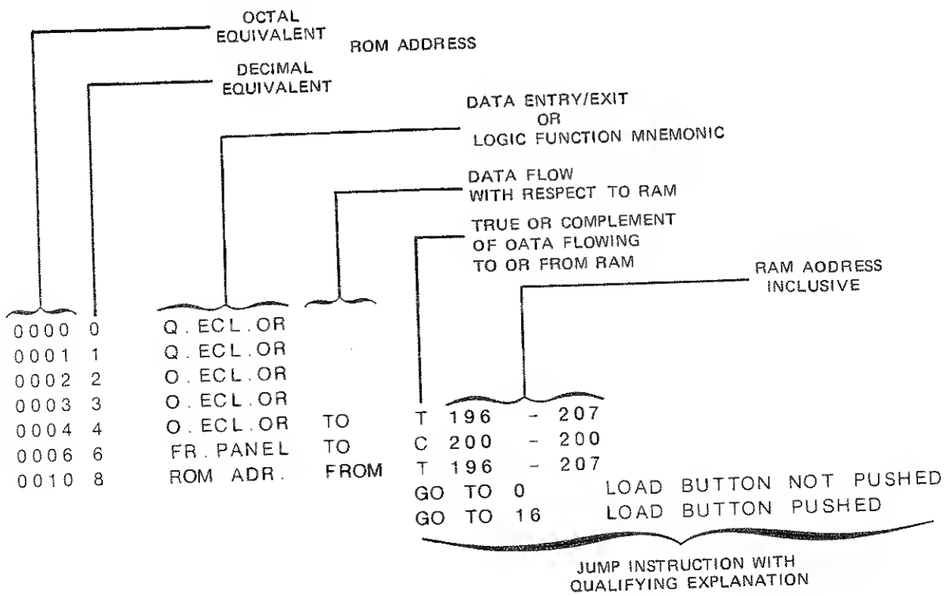


Figure 8-6. ROM Addresses 1-5

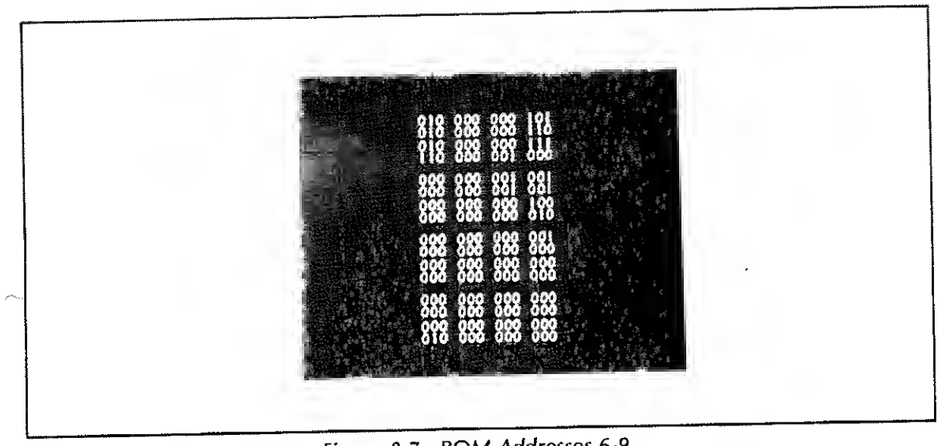


Figure 8-7. ROM Addresses 6-9

8-73. Figure 8-8 shows the implementation of ROM Address 8 and 9 when the LOAD button was pressed.

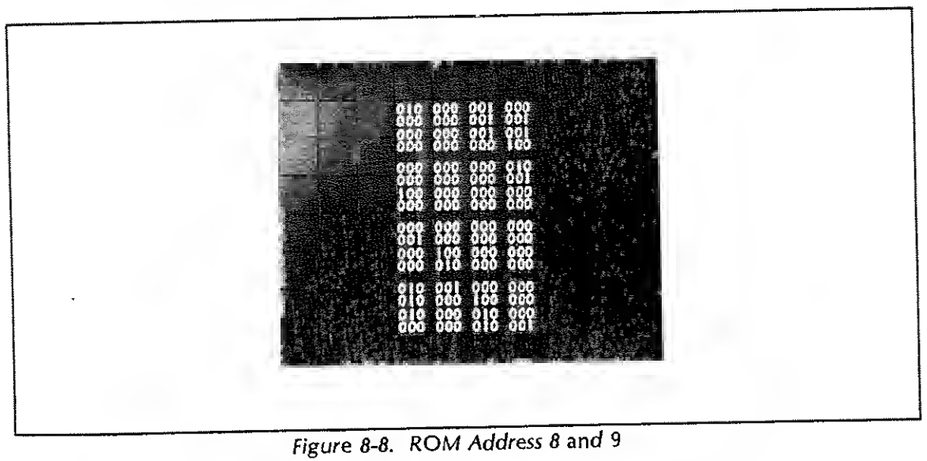


Figure 8-8. ROM Address 8 and 9

8-74. Note that in all cases the leftmost bit displayed is the serial data being transmitted to or from the RAM.

NOTE

Momentarily shorting A9(6) should cause the reset on pin 5 of A4, A5, A6, A8 and A9 to go low for approximately 3 seconds. Check that this resets the RAM and ROM address registers on the A5 and A9 boards to ø. This can also be used to reset the ROM program if it jumps the loop. The logic element used is the quad exclusive OR (op code 03_8) on the A4 board. This should be checked to insure that it is decoded at the ALU as 11_8 at U8 S_{0-3}. Check that data transfered from the front panel is high until the LOAD button is pushed and then one low bit is transfered via A5U20.

8-75. ROM Contents Allocation

8-76. Content allocation for the ROM and PROM boards is described in the following paragraphs:

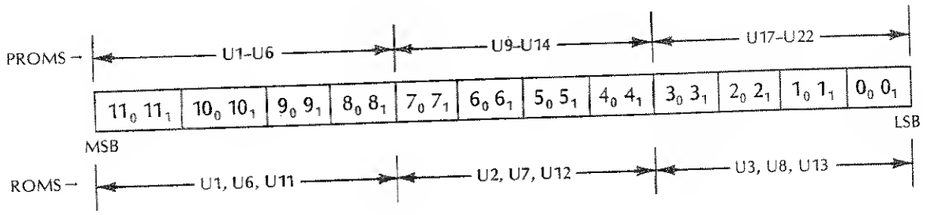
a. PROM boards (0S045-60030) are sectioned as follows:

Address	IC No.
0-511	U1,9,17
S12-1023	U2,10,18
1024-1S35	U3,11,19
1536-2047	U4,12,20
2048-2559	U5,13,21
2560-3071	U6,14,22

b. ROM boards (0S045-60008) are sectioned as follows:

Address	IC No.
0-1023	U1, 6, 11
1024-2047	U2, 7, 12
2048-3071	U3, 8, 13

c. Within each group of 3 PROMs or ROMs the bits are allocated as follows:



8-77. SELF CHECK TROUBLESHOOTING PROCEDURES

8-78. The operating procedures for performing the Self Check are described in Section III. the following paragraphs provide troubleshooting procedures to use when a failure occurs during the Self Check. The three-part Self Check (Self Check 1, 2 and 3) is described for both the standard 5045A (up to 16-pin ICs) and for Option 024 (up to 24-pin ICs).

8-79. Self Check 1 (Standard 5045A)

8-80. Self Check 1 (16 Program) has four tests which verify the ability to detect and register a failure on each of the pins.

a. Test 1-1: Checks pins 9-16 in the '1' state.

b. Test 1-2: Checks pins 1-8 in the '0' state.

c. Test 1-3: Checks pins 1-8 in the '1' state.

d. Test 1-4: Checks pins 9-16 in the '0' state.

8-81. If the failure detect circuitry is operating properly, the tester should register a pass each time, the four tests are performed, and the data is being set properly.

8-82. The program requires that the 16 pin Dummy IC (05045-80019) be installed in the 20 pin test socket. In the case of a handler, the IC should be in the handler test socket.

8-83. The switch settings recommended for running the Self Check 1 program are:

AUTO/MAN/HANDLR — Either position
ON FAILURE — HOLD
V AND I — Off (down)
PRINTER — ON

8-84. TROUBLESHOOTING. When a failure is printed, the two interconnected pins may both be printed as failed pins. The failure may be on either of the two pin driver boards and therefore further tests should be run to isolate the failed pin.

8-85. The general procedure for isolating a failure is listed below:

CAUTION

Turn off power before removing or installing printed-circuit boards. The A11 DAC and A13 thru A24 pin driver boards contain CMOS circuits which are highly susceptible to static discharge damage. Handle these boards only by the large black heat sink or the board extractor.

a. Interchange the pin driver boards associated with the failed pin with a pin driver board that did not register a failure, one board at a time. Rerun the program and see if the failure is registered on the same pin or has moved to the pin where the suspect board was moved to. If the failure has moved, then the problem is associated with the moved board and the troubleshooting procedure in paragraph 8-118 should be used.

b. If the failure has not moved, then the fault may be associated with the driver interconnected to the failed pin, the fast edge circuitry, or the control circuitry on A10, A11, or A12.

c. Interchanging boards should be used where possible to isolate the failure. This can be done on the pin driver and socket driver boards.

d. Where more than one group of pins is registered as failed and the grouping is every fourth pin (i.e., 1,5,9, etc.) the failure is probably associated with the failure detect circuitry on the A12 board or one of the pin driver boards listed as failed.

8-98. TROUBLESHOOTING. The tests in this program complements the tests in Self Check 2 and they are configured in such a way that they exercise the overall pin driver section of the tester in all modes. This program or the programs listed in paragraph 4-12 may be used to isolate the failure to the board and component. See paragraph 8-92 for a general procedure to isolate a failure.

8-99. Self Check 1 (Option 024)

8-100. Self Check 1 (24 Program) has four tests which verify the ability to detect and register a failure on each of the pins.

a. Test 1-1: Checks pins 13-24 in the '1' state.

b. Test 1-2: Checks pins 1-12 in the '0' state.

c. Test 1-3: Checks pins 1-12 in the '1' state.

d. Test 1-4: Checks pins 13-24 in the '0' state.

8-101. If the failure detect circuitry is operating properly, the tester should register a pass each time the four tests are performed.

8-102. The program requires that the 24-pin dummy IC (05045-80020) be installed in the 24-pin test socket. In the case of a handler, the IC should be installed in the handler test socket. The switch setting recommended for running the Self Check 1 program are:

AUTO — MAN/HNDLR — Either position
ON FAILURE — HOLD
V AND I — Off (down)
PRINTER — ON

8-103. TROUBLESHOOTING. When a failure is printed, the two interconnected pins may both be printed as failed pins. The failure may be on either of the two pin driver boards and therefore further tests should be run to isolate the failed pin.

8-104. The general procedure for isolating a failure is listed below:

a. Interchange the pin driver boards associated with the failed pin with a pin driver board that did not register a failure, one board at a time. Rerun the program and see if the failure is registered on the same pin or if it has moved to the pin where the suspect board was moved to. If the failure has moved, then the problem is associated with the moved board and the troubleshooting procedure in paragraph 8-118 should be used.

b. If the failure has not moved, then the fault may be associated with the driver interconnected to the failed pin, the fast edge circuitry, or the control circuitry on A10, A11 or A12.

c. Interchanging boards should be used where possible to isolate the failure. This can be done on the pin driver and socket driver boards.

d. Where more than 1 group of pins is registered as failed and the grouping is every fourth pin (i.e., 1,5,9, etc.), the failure is probably associated with the failure detect circuitry on the A12 board or one of the pin driver boards listed as failed.

8-105. Self Check 2 (Option 024)

8-106. Self Check 2 (pin drivers 24 program) contains ten tests that test the overall operation of the pin driver boards, the reference generator, the sample and hold circuits, and related circuitry.

8-107. A description of each test is as follows:

a. Test 2-1: Checks all pin drivers at the maximum voltages (7.5V) and at the crossover point on the low current range (250 μA). Pins 13-24 monitor and load pins 1-12. '0' and '1' states are exercised.

b. Test 2-2: Checks all pin drivers at maximum voltages (7.5V) and at the crossover point on the low current range. Pins 1-12 monitor and load pins 13-24. '0' and '1' states are exercised.

c. Test 2-3: Checks all pin drivers at the voltage crossover point (1.875V) and at the crossover point between Hi and Lo current ranges (2.5 mA). Pins 13-24 monitor and load pins 1-12. '0' and '1' states are exercised.

d. Test 2-4: Checks all pin drivers at the voltage crossover point (1.875V) and at the crossover point betwene Hi and Lo current ranges (2.5 mA). Pins 1-12 monitor and load pins 13-24. '0' and '1' states are exercised.

e. Test 2-5: Checks continuous current control on pin drivers 13-24. Pins 1-12 monitor pins 13-24. '0' and '1' states are exercised.

f. Test 2-6: Checks continuous current control on pin drivers 1-12. Pins 13-24 monitor pins 1-12. '0' and '1' states are exercised.

g. Test 2-7: Checks all pin drivers at the maximum voltage (7.5V) and maximum current (200 mA). Pins 13-24 monitor and load pins 1-12. Each pin combination (e.g., 1 and 24) is separately checked.

h. Test 2-8: Checks all pin drivers at the maximum voltage (7.5V) and maximum current (200 mA). Pins 1012 monitor and load pins 13-24. Each pin combination (e.g., 1 and 24) is separately checked.

i. Test 2-9: Checks all pin drivers at the maximum voltage (7.5V) and low current (20 μA). Pins 1-12 monitor and load pins 13-24. '0' and '1' states are exercised.

j. Test 2-10: Checks all pin drivers at the maximum voltage (7.5V) and low current (20μA). Pins 13-24 monitor and load pins 1-12. '0' and '1' states are exercised.

8-108. When the pin driver circuitry is operating properly, the tester should cycle and register a pass each time the ten tests are performed.

8-109. The test program requires the 24-pin dummy IC (05045-80020) to be installed in the test socket (in the case of a handler, the IC should be installed in the handler test socket).

8-110. TROUBLESHOOTING. The tests in this program are configured in such a way that they exercise the overall pin driver section of the tester in all modes. This program or the programs listed in paragraph 4-12 may be used to isolate the failure to the board and component.

8-111. The general procedure for isolating a failure is listed below:

a. Interchange the pin driver board associated with the failed pin with a pin driver board that did not register a failure. Rerun the program and see if the failure is registered on the same pin or if it has moved to the pin to where the suspect board was moved.

b. If the failure has moved then the problem is associated with the moved board and the troubleshooting procedure in paragraph 8-118 should be used.

c. If the failure has not moved then the faulty circuit may be associated with the driver interconnected to the failed pin driver, the fast edge circuitry or the control circuitry on A10, A11 or A12. Interchanging boards should be used where possible to isolate the failure. This can be done on the pin driver and socket driver boards.

8-126. For all tests in both the V/I R-Pack and the R-Pack C-Current Modes program, the odd and even pins for any pin driver board are set up with the same parameters. Comparison troubleshooting may be done with these programs.

8-127. Failing pins should be isolated by running the R-Pack Tests described in paragraph 4-16. Also, with the R-Pack removed from the test socket, actual programmed voltages and currents may be measured by probing the test points on the Test Head. Scopes, DVMs or other test equipment must be grounded to A30 TP25. The tolerances for voltages and currents when measured with the DVM is listed in Table 8-4.

Table 8-4. Tolerances for R-Pack Parameters

V/I R-Pack		R-Pack C-Current Modes	
Test 1	7V +/- 25 mV 7 mA +/- .42 mA	Test 1	7V +/- 25 mV 7 mA +/- 1.12 mA
Test 2	1V +/- 15 mV 1 mA +/- .06 mA	Test 2	1V +/- 15 mV 1 mA +/- .18 mA
Test 3	-7V +/- 25 mV -7 mA +/- .42 mA	Test 3	-7V +/- 25 mV -7 mA +/- 1.12 mA
Test 4	-1V +/- 15 mV -1 mA +/- .06 mA	Test 4	-1V +/- 15 mA -1 mA +/- .18 mA

Measurements made on A30 test points with DVM.

8-128. Current Source Troubleshooting

NOTE

All circuits on the pin driver boards are suspectible to loading and therefore high input impedance (10 MΩ) oscilloscopes and DVMs should be used to monitor this circuitry. A large portion of the circuitry on the pin driver boards is CMOS with very high input impedances and low output driver currents. The operational amplifiers are also high input impedance devices.

Leads which are strobed onto pin driver boards via bilateral switches should be measured using an oscilloscope unless otherwise specified. These levels should be measured during valid strobe in intervals only. Bilateral switches turn on when U20 pin 3 is high for odd pins and when U20 pin 11 is high for even pins. The high state is approximately +8V.

8-129. The correct (+) op amp voltage for current sources may be calculated by using the formulas below.

Positive Current Sources (+) inputs
Odd U13(16)
Even U3(6)

Negative Current Sources (+) inputs
Odd U11(6)
Even U1(6)

8-130. Each current source has a high and low range. For each test, refer to Table 8-5 for this information.

8-131. Calculation of (+) op amp voltage.

I is programmed level in mA.

+I Hi Range V(+) = 15 –.025I
–I Lo Range V(+) = 15 –2.025I)
–I Hi Range V(+) = –|15 –.025I|
–I Lo Range V(+) = –|15 –2.025I|
Note: |a| = absolute value of "a".
(see Figure 8-9)

Example:

A programmed current level of +7 mA is set up. 7 mA is in the Hi range; therefore the +I Hi Range equation is used.

The expected (+) op amp voltage is then:

$$15 - .025 \times 7 = 14.83V$$

8-132. When the current source is operating properly the (-) op amp voltage (pin 2) should be within 20 mV of the (+) input (pin 3). The output of the op amp (pin 6) should be approximately two diode drops above or below the (+) input depending on the polarity of the current source.

8-133. When troubleshooting a current source, also check the following:

a. Make sure that only 1 of the 3 gates in the current source is ON. The "A" gates are for the low current range and the "B" gates are for the high range. For positive current sources, the "ON" gates output voltage is within a few millivolts of the V_{SS} pin (pin 7). The other two gate outputs should be near +18V. For negative current sources, the "ON" gate's output voltage is within a few millivolts of the V_{DD} pin (pin 14). The two other negative current source gates should have outputs near -18V.

b. The continuous current bit is set high or low depending on the programmed mode. When continuous current is specified, a current source will produce current independent of the logic state. *These levels should be measured with* an *oscilloscope only.* The levels are strobed onto the pin driver boards via bilateral switches. Bilateral switches turn on when U20 pin 3 is in the high state (approximately 8V) for odd pins and U20 pin 11 for even pins. Measure the continuous bit voltage level during the valid strobe period. The expected logic states for the Resistor Pack programs are listed in Table 8-5.

+ Continuous I	U23(2) Odd Pins
	U23(3) Even Pins
-Continuous I	U23(10) Odd Pins
	U23(9) Even Pins

Logic H Level 2.5 to 5V (approx.)
Logic L Level -2.5 to -5V (approx.)

c. The logic state for a pin is determined by the "Odd Pin Test Pattern Setup" or the "Even Pin Test Pattern Setup" control lines.

The logic levels should be measured on U22(12) for odd pins and U22(2) for even pins. Refer to Table 8-5 for expected levels.

Logic H Level +8V (approx.)
Logic L Level -8V (approx.)

d. Turn on the 5045A and load Self Check 2. Do not use dummy IC.

e. The PASS light should flash at a consistent rate. This indicates that the processor and memory are functioning correctly.

f. If the FAIL light flashes then the processor or memory and associated control has a malfunction. Refer to processor troubleshooting paragraph 8-57.

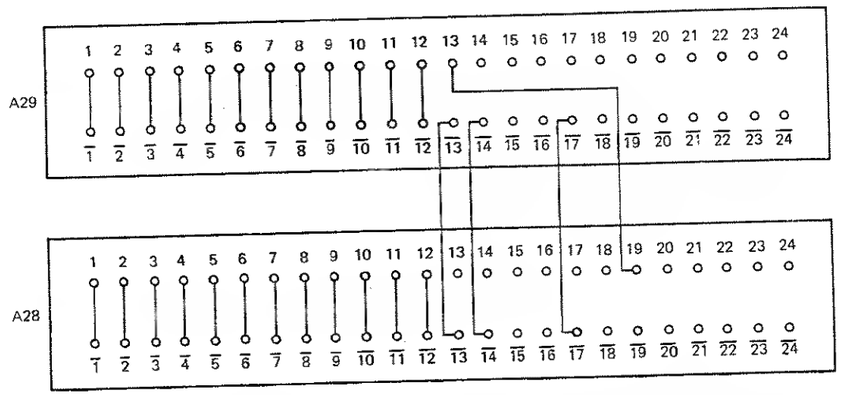
g. If the pass light flashes then one of the pindriver boards is bad.

h. Turn the power off. Set "START" to "MAN/HANDLR."

i. Insert one pindriver board and load Self Check 3. DO NOT USE THE DUMMY IC. Press TEST. Pass light should illuminate. Verify front panel operation by pressing TEST several times and then try to reload the card. If these front panel controls function correctly then turn off the 5045A and insert another pindriver board. Again verify correct operation. Continue this procedure until the bad board is found. When the bad pindriver is isolated, remove all of the others. Remove the ground jumper from A12 and troubleshoot the bad board by using the Current Source Troubleshooting procedure.

8-145. Troubleshooting the Fast Edge (Socket Driver) Circuitry

8-146. Positive and negative fast edge magnetic card program (05045-18009) and the procedure listed in paragraph 5-9 should be used to check each circuit.



8-147. To gain access to the failed board use above procedure and isolate the failed pin. Interchange the boards if necessary to place the failed board in the A29 position (upper board). Remove the A30 Socket board and the A31 Interconnect board. Connect the A28 and 29 boards together using two 24-pin connectors wired as follows:

8-148. Checks to be performed on the failed board using the fast edge program cards:

a. Check that data is shifted into circuits U7 and U8.

b. The control and generation of information to the fast edge circuitry is controlled by the A12 Pin Driver Control U1-U3, U6-U9. Information designating which pin drivers are driving inputs and which are monitoring outputs is contained in U2. This information is ANDed with the next logic state information in U3D. This information is fed to the A28 and A29 socket driver (fast edge) boards via U3(11) and connector J6. This data is fed in parallel to both boards. Data is clocked onto the A28 board using the output of U3(8) via connector J4 and to the A29 board using the U3(6) via connector J5 output.

c. Check that the data is transfered from U7 and U8 to U4 and U5.

d. The transfer from A28/A29 U7 and U8 to U4 and U5 is controlled by the signal generated at U3(3) and output via connector J5.

e. Check that the transistors are turned on for at least 3 μs.

f. Check that the '1' state storage capacitor for each fast edge circuit is charged to the '1' state level while the test socket pin is in the '0' state and the '0' state storage capacitor is charged to the '0' state level while the test socket pin is in the '1' state. These capacitors are charged from the voltage source on the corresponding pin driver circuit.

8-149. A8 ROM LISTINGS

8-150. The ROM listing in connection with the ROM flow chart and an HP 1601 Logic State Analyzer can be used to verify the information flow in the instrument.

```
                -(0-8) INITIAL
                -WAIT FOR LOAD BUTTON TO BE PRESSED
0000 0          O.ECL.OR
0001 1          Q.ECL.OR
0002 2          O.ECL.OR
0003 3          O.ECL.OR
0004 4          O.ECL.OR    TO      T 196   - 207
0006 6          FR.PANEL    TO      C 200   - 200
0010 8          ROM ADR.    FROM    T 196   - 207
                                    GO TO 0     LOAD BUTTON NOT PUSHED
                                    GO TO 16    LOAD BUTTON PUSHED

                -(16-36) CLEAR MM
                -LOOP 255 TIMES
0020 16         O.ECL.OR    TO      T 187   - 199
0022 18         A-ONE       FROM    C 187   - 190
0024 20         A-ONE       TO      C 187   - 190   ,C 195
0027 23         A-ONE       FROM    C 191   - 195
0031 25         A-ONE       TO      C 191   - 194   ,C 198
0034 28         COPY        FROM    C 198   - 198   ,T 198
0037 31         COPY        TO      T 200   - 225   ,C 197
0042 34         M.MEM.      FROM    T 202   - 225
0044 36         ROM ADR.    FROM    T 196   - 207
                                    GO TO 18    MAIN MEM CLEAR LOOP LESS THAN 255
                                    GO TO 38    MAIN MEM CLEAR LOOP FINISHED

                -(38-44) WAIT FOR LOAD BUTTON
0046 38         FR.PANEL    TO      C 199   - 199
0050 40         O.ECL.OR    TO      T 33    - 60    ,C 56   ,T 2
0054 44         ROM ADR.    FROM    T 196   - 207
                                    GO TO 38    LOAD BUTTON NOT PUSHED
                                    GO TO 46    LOAD BUTTON PUSHED

0056 46         ROM ADR.    TO      T 499   - 510   ,STORE ROM ADR: 47
0060 48         ROM ADR.    FROM    T 49    - 60
                                    GO TO 128   RTN 50 GO TO MAG CARD SUB

                -(50-90) INITIAL D/A SET UP
0062 50         CONSTANT    TO      T 285   - 286
                ( 33    )   TO      T 287   - 294
                ( 30    )   TO      T 295   - 302
                ( 277   )   TO      T 303   - 310
                ( 11    )   TO      T 311   - 318
                ( 200   )   TO      T 319   - 326
                ( 4     )   TO      T 327   - 334
                ( 10    )   TO      T 335   - 342
                ( 0     )   TO      T 343   - 350
0074 60         A-ONE       TO      T 404   - 408   ,T 404
0077 63         O.ECL.OR    TO      T 212   - 223   ,C 221
0102 66         DECODER     TO      T 375   - 391
0104 68         ROM ADR.    TO      T 499   - 510   ,STORE ROM ADR: 69
0106 70         ROM ADR.    FROM    T 380   - 391
                                    GO TO 2048  RTN 72 GO TO D/A IN/OUT SUB

0110 72         DECODER     TO      T 302   - 311   ,C 289   ,T 329
0114 76         ROM ADR.    TO      T 499   - 510   ,STORE ROM ADR: 77
0116 78         ROM ADR.    FROM    T 315   - 326
                                    GO TO 2048  RTN 80 GO TO D/A IN OUT SUB
```

```
0120  80   A-ONE        FROM  C 289   - 289
0122  82   A-ONE        TO    C 289   - 289   ,T 294
0125  85   A-ONE        FROM  C 290   - 294
0127  87   A-ONE        TO    C 290   - 293   ,C 300
0132  90   ROM ADR.     FROM  T 296   - 307
                             GO TO 76     PIN SET-UP NOT FINISHED
                             GO TO 92     FINISHED '0' ING PIN SET-UP

          -(94-100) CHECK SUM COMPARE 4LSB
0134  92   M.M. ADV     FROM  T 343   - 350
0136  94   COPY         FROM  T 128   - 131
0140  98   COPY         TO    T 94    - 98
0142  98   COMPARE      FROM  T 94    - 102
0144  100  COMPARE      TO    T 94    - 94
0148  102  COPY         FROM  T 132   - 135
0150  104  COPY         TO    T 98    - 102
0152  106  CONSTANT     TO    T 382   - 383
           ( 50  ) TO  T 384  - 391
           ( 2   ) TO  T 392  - 399
           ( 164 ) TO  T 400  - 407
           ( 100 ) TO  T 408  - 415
           ( 11  ) TO  T 416  - 423
           ( 0   ) TO  T 424  - 431
           ( 245 ) TO  T 432  - 439
           ( 44  ) TO  T 440  - 447
           ( 142 ) TO  T 448  - 455
           ( 1   ) TO  T 456  - 463
           ( 22  ) TO  T 464  - 471
           ( 2   ) TO  T 472  - 479
           ( 200 ) TO  T 480  - 487
           ( 167 ) TO  T 488  - 495
           ( 140 ) TO  T 496  - 503
           ( 12  ) TO  T 504  - 511
0174  124  M.MEM.       FROM  T 28    - 51
0176  126  ROM ADR.     FROM  T 464   - 475
                             GO TO 530    RTN 336 GO TO TITLE SEARCH SUB IN MM

          -(128-335) CARD READER SUBROUTINE
0200  128  O.ECL.OR     TO    T 96    - 122
0202  130  O.ECL.OR     TO    T 128   - 156
0204  132  COPY         FROM  T 500   - 509
0206  134  COPY         TO    C 214   - 243
0210  136  ROM ADR.     TO    T 499   - 510   ,STORE ROM ADR: 137
0212  138  A-ONE        TO    C 499   - 503
0214  140  DECODER      TO    T 3     - 32    ,C 18    ,C 19
0220  144  EXT.CONT     FROM  T 2     - 9
0222  146  EXT.CONT     TO    C 502   - 502
          -WAIT FOR CARD IN
0224  148  CARD RDR     FROM  C 4     - 7
0226  150  ROM ADR.     FROM  T 499   - 510
                             GO TO 144    CARD NOT IN
                             GO TO 152    CARD IN

          -(152-166) SET UP FOR TIME DELAY
          -16MS DELAY
0230  152  O.ECL.OR     TO    C 26    - 28
0232  154  ROM ADR.     FROM  T 9     - 20
                             GO TO 1536   RTN 156 8 MSEC DELAY
```

```
0234 156  A-ONE          FROM  C 2     - 2
0236 158  A-ONE          TO    C 504   - 506  ,T 507  ,T 500  ,T 503
,T 505  ,T 501  ,T 511
0246 166  ROM ADR.       FROM  T 9     - 20
                               GO TO 1536  RTN 174 DO 8 MSEC DELAY THEN READ
                                                   CARD SUB
                                           268 RTN TO WRITE CARD SUB


0250 168  CARD RDR       TO    T 95    - 98
0252 170  ROM ADR.       FROM  T 21    - 32
                               GO TO 224   RTN 172 24 BIT WORD FROM CRD RDR
                                                   COMPLETE
                                           174 24 BIT WORD FROM CRD RDR
                                                   NOT COMPLETE


          -(174) READ CARD SUBROUTINE
0254 172  M.MEM.         FROM  T 99    - 122
0256 174  CARD RDR       FROM  C 4     - 7
0260 176  O.ECL.OR       TO    T 500   - 501
0262 178  EXT.CONT       TO    C 504   - 505
0264 180  QUAD OR        FROM  C 504   - 505  ,C 504  ,C 505  ,C 504
0271 185  QUAD OR        TO    C 502   - 502  ,T 503  ,T 505
          -WAIT FOR MFL
0275 189  ROM ADR.       FROM  T 499   - 510
                               GO TO 176   NO CLOCK
                               GO TO 168   CARD AND CLOCK
                               GO TO 208   END OF CARD


0300 192  EXT.CONT       TO    T 501   - 501
0302 194  ROM ADR.       FROM  T 499   - 510
                               GO TO 192   CARD NOT IN
                               GO TO 196   CARD IN


0304 196  M.M. ADV       FROM  T 9     - 16
0306 198  COPY           FROM  T 154   - 154
0310 200  COPY           TO    T 90    - 90
0312 202  ROM ADR.       TO    T 499   - 510  ,STORE ROM ADR: 203
0314 204  ROM ADR.       FROM  T 9     - 20
                               GO TO 1536  RTN 206    DO 8 MSEC DELAY


0316 206  ROM ADR.       FROM  T 9     - 20
                               GO TO 1536  RTN 210  DO 8 MSEC DELAY


0320 208  NOP
0321 209  NOP
0322 210  COPY           FROM  C 214   - 223
0324 212  COPY           TO    T 500   - 510
0326 214  A-ONE          FROM  C 90    - 90
0330 216  A-ONE          TO    T 233   - 233  ,C 231  ,C 226
0334 220  EXT.CONT       FROM  T 9     - 16
0336 222  ROM ADR.       FROM  T 224   - 235
                               GO TO 132   NO END CODE FOUND
                               GO TO 512   END CODE FOUND
```

```
          -(224-235) CALCULATE CHECK SUM
          -(237-239 + 258-264) CHECK FOR END CODE
0340 224  A+B        FROM  T 128  - 131  ,T 511  ,T 120  ,T 121
,T 122
0346 230  A+B        TO    T 128  - 131  ,T 136
0351 233  A+B        FROM  T 132  - 136
0353 235  A+B        TO    T 132  - 135
0355 237  OR         FROM  C 120  - 122
0357 239  OR         TO    C 140  - 140
0361 241  COPY       FROM  T 110  - 119
0363 243  COPY       TO    T 113  - 122
0365 245  COPY       FROM  T 100  - 109
0367 247  COPY       TO    T 103  - 112
0371 249  CDPY       FROM  T 96   - 99
0373 251  COPY       TO    T 99   - 102
0375 253  A-ONE      FROM  C 137  - 139
0377 255  A-ONE      TO    C 137  - 139  ,C 500
0402 258  COPY       FROM  T 140  - 149
0404 260  COPY       TO    T 141  - 150
          -CHECK IF 1 IN S.R. - END CODE FOUND
0406 262  OR         FROM  C 141  - 148
0410 264  OR         TO    C 90   - 90
0412 266  ROM ADR.   FROM  T 224  - 235
                     GO TO 512

          -(268-335) WRITE SUBROUTINE
0414 268  CARD RDR   FROM  C 4    - 7
0416 270  ROM ADR.   FROM  T 9    - 20
                     GO TO 1536  DO 8 MSEC DELAY RTN 272

0420 272  M.MEM.     TO    T 99   - 122
0422 274  ROM ADR.   FROM  T 9    - 20
                     GO TO 1536  DO 8 MSEC DELAY RTN 276

0424 276  CARD RDR   FROM  C 4    - 7
0426 278  CARD RDR   FROM  T 120  - 123
0430 280  O.ECL.OR   TO    T 236  - 243  ,C 240  ,C 240
0434 284  ROM ADR.   TO    T 499  - 510  ,STORE ROM ADR: 285
0436 286  ROM ADR.   FROM  T 9    - 20
                     GO TO 1536  DO 8 MSEC DELAY RTN 288

0440 288  CARD RDR   FROM  T 120  - 123
0442 290  ROM ADR.   FROM  T 21   - 32
                     GO TO 224   RTN 292 GET NEW WORD FROM MAIN MEM
                                         IF FINISHED OLD WORD
                                     294 STILL PROCESSING OLD WORD

0444 292  M.MEM.     TO    T 99   - 122
0446 294  OUAD OR    FROM  T 500  - 500  ,C 90   ,C 500
0452 298  OUAD OR    TO    T 502  - 502  ,T 155
0455 301  Q.ECL.OR   TO    T 238  - 243
0457 303  O.ECL.OR   TO    T 500  - 501  ,C 503
0482 306  ROM ADR.   FROM  T 9    - 20
                     GO TO 1536  RTN 308 HAVE END CODE
                                     316 NO END CODE
```

```
0742 482  EXT.CONT   FROM  C 492  - 499
0744 484  A-ONE      FROM  C 192  - 192
0746 486  A-ONE      TO    C 456  - 456  ,C 464
0751 489  ROM ADR.   FROM  T 455  - 466
                           GO TO 530 RTN 492 TEST BUTTON PRESSED
                                         494 WRITE BUTTON PRESSED
                           GO TO 16    LOAD BUTTON PRESSED

0754 492  ROM ADR.   FROM  T 461  - 472
                           GO TO 1352  GO TO TEST PROG PREPERATION SUB

0756 494  O.ECL.OR   TO    T 467  - 484
0760 496  ROM ADR.   FROM  T 455  - 466
                           GO TO 530   RTN 498 LOOK FOR TITLE CODE FFFBEF

0762 498  DECODER    FROM  T 193  - 193
0764 500  DECODER    TO    C 219  - 219  ,C 221  ,C 2    ,T 204
0771 505  M.M. ADV   FROM  T 464  - 471
0773 507  A-ONE      TO    T 499  - 504  ,T 500
0776 510  ROM ADR.   FROM  T 212  - 223
                           GO TO 512   RTN SUB
                           GO TO 128   RTN 464 WRITE MAG CARD SUB

          -(512-528) RETURN SUBROUTINE
1000 512  A-ONE      FROM  C 501  - 502
1002 514  A-ONE      TO    C 501  - 502  ,T 511
1005 517  A+B        FROM  T 503  - 506  ,T 511
1010 520  A+B        TO    T 503  - 506  ,T 511
1013 523  A+B        FROM  T 507  - 511
1015 525  A+B        TO    T 507  - 511  ,T 499
1020 528  ROM ADR.   FROM  T 499  - 510
                           GO TO RETURN ADDRESS

          -(530-584) TITLE SEARCH SUBROUTINE
1022 530  O.ECL.OR   TO    T 212  - 223  ,C 221  ,C 485
1026 534  M.MEM.     TO    T 256  - 279
1030 536  COMPARE    FROM  T 256  - 259  ,T 511  ,T 487  ,T 488
,T 489  ,T 490
1037 543  COMPARE    TO    T 280  - 280
1041 545  COMPARE    FROM  T 260  - 263  ,T 511  ,T 491  ,T 492
,T 493  ,T 494
1050 552  COMPARE    TO    T 263  - 263
1052 554  OR         FROM  C 271  - 277
1054 556  OR         TO    C 266  - 266
1056 558  OR         FROM  C 263  - 270
1060 560  OR         TO    C 277  - 277
1062 562  A-ONE      FROM  C 477  - 480  ,T 485
1065 565  A-ONE      TO    C 477  - 480  ,C 485
1070 568  A-ONE      FROM  C 481  - 485
1072 570  A-ONE      TO    C 481  - 485
1074 572  OR         FROM  C 277  - 280
1076 574  OR         TO    C 486  - 486
1100 576  OUAD OR    FROM  T 485  - 486  ,T 485  ,T 486
1104 580  OUAD OR    TO    C 215  - 216
1106 582  M.MEM.     TO    T 256  - 279
1110 584  ROM ADR.   FROM  T 212  - 223
                           GO TO 536   TITLE CODE NOT FOUND
                           GO TO 512   TITLE CODE FOUND, GOTO RTN ADDRESS
                                       OR LOOPED 256  TIMES
```

```
          -BLANK LOADER FOR PRINTER SUBROUTINE
1112 586  O.ECL.OR  TO     T 212  - 223
1114 588  Q.ECL.OR  TO     C 217  - 218  ,C 215  ,C 222
1120 592  CONSTANT  TO     T 228  - 229
          ( 40   ) TO  T 230  - 237
          ( 10   ) TO  T 238  - 245
          ( 202  ) TO  T 246  - 253
          ( 40   ) TO  T 254  - 261
          ( 10   ) TO  T 262  - 269
          ( 202  ) TO  T 270  - 277
          ( 40   ) TO  T 278  - 285
          ( 10   ) TO  T 286  - 293
          ( 202  ) TO  T 294  - 301
          ( 40   ) TO  T 302  - 309
          ( 10   ) TO  T 310  - 317
          ( 202  ) TO  T 318  - 325
          ( 40   ) TO  T 326  - 333
          ( 10   ) TO  T 334  - 341
          ( 202  ) TO  T 342  - 349
1141609   ROM ADR.  FROM  T 212  - 223
                        GO TO 1128  IF STARTED 586
                        GO TO RETURN ADDRESS IF STARTED 592

          -(612-744) REFERENCE GENERATOR
          -SET UP SUBROUTINE
1144 612  M.MEM.     TO     T 280  - 303
1146 614  A-ONE      TO     T 438  - 443
1150 616  M.MEM.     TO     T 410  - 433
1152 618  COPY       FROM   C 266  - 267  ,C 416  ,C 290  ,T 291
1157 623  COPY       TO     C 404  - 431  ,T 286  ,T 267  ,T 290
,C 291
1165 629  CONSTANT   TO     T 500  - 501
          ( 116  ) TO  T 502  - 509
1170 632  COPY       FROM   T 303  - 303
1172 634  COPY       TO     T 491  - 493  ,T 489  ,C 494
1176 638  ROM ADR.   FROM   T 487  - 498
                        GO TO 640   NEED TO DO '1' COMPLEMENT OF SETUP
                        GO TO 656   '1' COMPLEMENT NOT NEEDED

1200 640  A-ONE      FROM   T 293  - 294
1202 642  A-ONE      TO     C 293  - 294  ,T 350
1205 645  A-ONE      FROM   T 295  - 298  ,C 350
1210 648  A-ONE      TO     C 295  - 298  ,T 350
1213 651  A-ONE      FROM   T 299  - 302  ,T 350
1216 654  A-ONE      TO     C 299  - 303
1220 656  A-ONE      FROM   T 427  - 428
1222 658  A-ONE      TO     T 427  - 438
1224 660  COPY       FROM   T 303  - 303  ,T 302  ,T 301  ,T 300
,T 299
,T 298  ,T 297  ,T 296  ,T 295  ,T 294
1237 671  COPY       TO     T 296  - 305
1241 673  COPY       FROM   T 293  - 293  ,T 292
1244 676  COPY       TO     T 306  - 307
1246 678  A-ONE      FROM   C 431  - 431
1250 680  A-ONE      TO     C 501  - 502  ,T 503  ,T 505  ,T 508
,C 501
1256 686  ROM ADR.   FROM   T 432  - 443
                        GO TO 896   RTN 632 DATA RFG FROM MM TO D/A NOT
                                    FINISHED
                                688 DATA RFG FINISHED
```

```
1260 688  M.M. ADV   FROM   T 212   - 219
1262 690  M.MEM.     TO     T 232   - 255
1264 692  DECODER    TO     T 375   - 391
1266 694  M.MEM.     TO     T 256   - 279
1270 696  COPY       FROM   C 232   - 239
1272 698  COPY       TO     T 288   - 295   ,T 287
1275 701  OR         FROM   C 236   - 237
1277 703  OR         TO     T 494   - 494
1301 705  A-ONE      FROM   C 494   - 494
1303 707  A-ONE      TO     C 435   - 435   ,T 433
1306 710  ROM ADR.   TO     T 499   - 510   ,STORE ROM ADR: 711
1310 712  ROM ADR.   FROM   C 424   - 435
                    GO TO 2048   PARAMETRIC INFO IN MM SENT TO/
                                 FROM D/A
                    GO TO 512    RTN 714 TRANSFER COMPLETED

1312 714  A-ONE      FROM   C 375   - 376
1314 716  A-ONE      TO     C 375   - 377
1316 718  DECODER    FROM   C 239   - 239   ,T 494
1321 21   DECODER    TO     C 492   - 492   ,T 493
1324 724  OUAD OR    FROM   C 493   - 493   ,C 493   ,C 494   ,C 377
,C 494
1332 730  OUAD OR    TO     C 489   - 491
1334 732  COPY       FROM   T 241   - 250
1336 734  COPY       TO     T 233   - 242
1340 736  COPY       FROM   T 251   - 255
1342 738  COPY       TO     T 243   - 255
1344 740  CONSTANT   TO     C 500   - 501
          ( 121 ) TO C 502   - 509
1347 743  ROM ADR.   FROM   T 487   - 498
                    GO TO 696    END LIST OF PIN NO. NOT REACHED
                    GO TO 688    NEED TO INPUT ANOTHER WORD FROM MM
                    GO TO 612    SET-UP DATA FOR NEW PARAMETRIC INFO
                    GO TO 512    END OF PAMETRIC INFO SET-UP

          -(746-821) SUBROUTINE
          -(A+-B)A
          -AB
          -(A+-1)B
          -AB)
          -(A+-16)B
          -(B-A)
          -BB
1352 746  O.ECL.OR   TO     T 409   - 413   ,T 415
1355 749  O.ECL.OR   TO     T 421   - 429
1357 751  COPY       FROM   T 417   - 418
1361 753  COPY       TO     C 430   - 430   ,C 425
1364 756  OUAD OR    FROM   C 410   - 410   ,C 412   ,T 420   ,C 402
,T 4021372 762  OUAD OR    TO     T 214   - 214   ,C 431   ,T 432
1376 766  A-ONE      FROM   C 409   - 412
1400 768  A-ONE      TO     C 409   - 412
1402 770  COMPARE    FROM   T 409   - 416
1404 772  COMPARE    TO     T 426   - 426
1406 774  O.ECL.OR   FROM   C 426   - 426   ,T 418   ,T 417   ,C 431
,T 288   ,T 419
1415 781  O.ECL.OR   TO     T 426   - 426   ,T 431   ,T 421
1421 785  COPY       FROM   T 278   - 287
1423 787  COPY       TO     T 279   - 288
```

```
1425 789  A+B          FROM  T 421  - 426
1427 791  A+B          TO    T 426  - 426  ,T 425
1432 794  A+B          FROM  T 426  - 431
1434 796  A+B          TO    T 426  - 426  ,T 430
1437 799  AND OR       FROM  T 432  - 433  ,C 433  ,T 426
1443 803  AND OR       TO    T 278  - 278
1445 805  COPY         FROM  T 392  - 401
1447 807  COPY         TO    T 393  - 402
1451 809  AND OR       FROM  C 434  - 434  ,T 426  ,T 434  ,T 432
1456 814  AND OR       TO    T 392  - 392
1460 816  A-ONE        FROM  C 214  - 214
1462 818  A-ONE        TO    T 216  - 219
1464 820  ROM ADR.     FROM  T 212  - 223
                         GO TO 756   TRANSFER DATA NOT COMPLETED
                         GO TO 512   TRANSFER DATA COMPLETED

          -PASS/FAIL ANALYSIS
          -RETURN FROM MM LOGIC PROGRAM SOURCE
1466 822  PIN DRV   FROM  T 1    - 30
1470 824  M.M. ADV  FROM  C 272  - 279
1472 826  FR.PANEL  TO    C 457  - 462  ,T 202  ,C 461
1476 830  OR        FROM  T 447  - 447  ,C 460  ,C 203
1502 834  OR        TO    C 275  - 275
1504 836  OR        FROM  T 457  - 459
1506 838  OR        TO    C 508  - 508
1510 840  COPY      FROM  T 507  - 511  ,T 511  ,T 508
1514 844  COPY      TO    C 500  - 506
1516 846  DECODER   FROM  T 449  - 449  ,C 508
1521 849  DECODER   TO    T 503  - 504
1523 851  CONSTANT  TO    T 303  - 304
          ( 271 ) TO  T 305  - 312
          ( 201 ) TO  T 313  - 320
          ( 11  ) TO  T 321  - 328
          ( 132 ) TO  T 329  - 336
1531 857  ROM ADR.   FROM  T 325  - 336
                         GO TO 1440   RTN 464 LOAD, WRITE OR TEST
                                              BUTTON PUSHED
                                          860 LOAD, WRITE OR TEST BUTTON
                                              NOT PUSHED AND STOP ON FAIL
                                          876 CONTINUE ON FAIL

1534 860  PIN DRV   TO    T 241  - 271
1536 862  OR        FROM  T 248  - 255
1540 864  OR        TO    T 272  - 272
1542 866  OR        FROM  T 256  - 263
1544 868  OR        TO    T 273  - 273
1546 870  OR        FROM  T 264  - 271
1550 872  OR        TO    T 274  - 274
1552 874  OR        FROM  T 272  - 275
1554 876  OR        TO    T 307  - 307
1556 878  ROM ADR.   FROM  T 304  - 315
                         GO TO 882   CONTINUE TESTING
                         GO TO 890   FAILURE OCCURED

1560 880  M.M. ADV  FROM  T 477  - 484
1562 882  CONSTANT  TO    T 497  - 498
          ( 66  ) TO  T 499  - 506
1565 885  ROM ADR.   FROM  T 436  - 447
                         GO TO  1470  (NEXT TEST) MAIN MEM AS PROG SOURCE
```

```
1570 888  M.M. ADV   FROM   C 272  - 279
1572 890  O.ECL.OR   TO     C 203  - 204  ,T 206  ,T 458
1576 894  ROM ADR.   FROM   T 314  - 325
                     GO TO  1216  FAILURE OCCURED

          -(896-958) 6 BIT PER PASS
          -RIGHT SHIFT SUBROUTINE UP TO
          -16 PASSES PROGRAMMABLE
1600 896  COPY       FROM   T 344  - 349
1602 898  COPY       TO     T 224  - 229
1604 900  COPY       FROM   T 334  - 343
1606 902  COPY       TO     T 340  - 349
1610 904  COPY       FROM   T 324  - 333
1612 906  COPY       TO     T 330  - 339
1614 908  COPY       FROM   T 314  - 323
1616 910  COPY       TO     T 320  - 329
1620 912  COPY       FROM   T 304  - 313
1622 914  COPY       TO     T 310  - 319
1624 916  COPY       FROM   T 294  - 303
1626 918  COPY       TO     T 300  - 309
1630 920  COPY       FROM   T 284  - 293
1632 922  COPY       TO     T 290  - 299
1634 924  COPY       FROM   T 274  - 283
1636 926  COPY       TO     T 280  - 289
1640 928  COPY       FROM   T 264  - 273
1642 930  COPY       TO     T 270  - 279
1644 932  COPY       FROM   T 254  - 263
1646 934  COPY       TO     T 260  - 269
1650 936  COPY       FROM   T 244  - 253
1632 922  COPY       TO     T 290  - 2990
1634 924  COPY       FROM   T 274  - 283
1636 926  COPY       TO     T 280  - 289
1640 928  COPY       FROM   T 264  - 273
1642 930  COPY       TO     T 270  - 279
1644 932  COPY       FROM   T 254  - 263
1646 934  COPY       TO     T 260  - 269
1650 936  COPY       FROM   T 244  - 253
1652 938  COPY       TO     T 250  - 259
1654 940  COPY       FROM   T 234  - 243
1656 942  COPY       TO     T 240  - 249
1660 944  COPY       FROM   T 224  - 233
1662 946  COPY       TO     T 230  - 239
1664 948  A-ONE      FROM   T 431  - 434
1666 950  A-ONE      TO     T 431  - 434  ,T 219
1671 953  COPY       FROM   T 219  - 219
1673 955  COPY       TO     T 220  - 220
1675 957  ROM ADR.   FROM   T 212  - 223
                     GO TO  896   ROTATE DATA
                     GO TO  512   END ROTATION OF DATA

          -(960-1099) FAILURE PRINTOUT FORMATTERO BE
          -(208-211) NUMBER OF PIN IN IC
          -STORED IN NODES
1700 960  A-ONE      TO     C 441  - 446  ,T 241
1703 963  A-B-ONE    FROM   T 208  - 213  ,C 511
1706 966  A-B-ONE    TO     T 494  - 510
1710 968  FR.PANEL   FROM   T 204  - 207
1712 970  ROM ADR.   TO     T 448  - 459  ,STORE ROM ADR: 971
```

```
1714 972   COPY        FROM   T 366   - 375
1716 974   COPY        TO     T 367   - 375   ,T 351
1721 977   COPY        FROM   T 356   - 365
1723 979   COPY        TO     T 357   - 366
1725 981   COPY        FROM   T 350   - 355
1727 983   COPY        TO     T 351   - 356
1731 985   A-B-ONE     FROM   T 494   - 498   ,T 441
1734 988   A-B-ONE     TO     T 494   - 510   ,C 509
1737 991   DECODER     FROM   T 442   - 446
1741 993   DECODER     TO     T 422   - 427   ,C 500
1744 996   A-ONE       FROM   T 441   - 442
1746 998   A-ONE       TO     T 441   - 442   ,T 350
1751 1001     A-ONE       FROM   T 443   - 446   ,C 350
1754 1004     A-ONE       TO     T 443   - 446   ,T 350
1757 1007     OUAD OR     FROM   C 350   - 350   ,C 352
1762 1010     QUAD OR     TO     T 492   - 493
1764 1012     COPY        FROM   T 493   - 497
1766 1014     COPY        TO     T 410   - 440
1770 1016     COPY        FROM   T 414   - 414   ,T 414
1773 1019     COPY        TO     T 382   - 404   ,T 448
1776 1022     ROM ADR.    FROM   T 499   - 510
                             GO TO  1024  DETERMINATION OF  OF PINS NOT
                                          FINISHED
                             GO TO  1026  DETERMINATION FINISHED

2000 1024     A-ONE       TO     T 493   - 498
2002 1026     AND OR      FROM   T 444   - 446   ,T 446
2005 1029     AND OR      TO     C 503   - 503
2007 1031     DECODER     FROM   T 492   - 492   ,C 351
2012 1034     DECODER     TO     C 500   - 500   ,T 502
2015 1037     QUAD OR     FROM   C 502   - 503
2017 1039     QUAD OR     TO     T 501   - 501   ,C 503   ,C 387
2023 1043     CONSTANT    TO     C 430   - 431
           ( 317  ) TO    C 432   - 439
2026 1046     ROM ADR.    FROM   T 429   - 440
                             GO TO 390    RTN 1048 NO FAILURE
                                           1050 NO MORE INFO FOR PRINTER
                                           1054 FULL LINE READY TO BE
                                                PRINTED
                                           1058 FAILURE INFO

2030 1048     ROM ADR.    FROM   T 448   - 459
                             GO TO 970    NO FAILURE

2032 1050     DECODER     TO     T 483   - 465
2034 1052     ROM ADR.    FROM   T 462   - 473
                             GO TO  1746  NO MORE INFO FOR PRINTER
2036 1054     COPY        FROM   T 382   - 387   ,C 337   ,C 441
2042 1058     COPY        TO     T 327   - 329   ,T 332   ,T 333   ,T 330
,T 214   ,T 326
2051 1065     OUAD OR     FROM   T 332   - 333   ,T 337   ,T 214   ,T 214
2056 1070     OUAD OR     TO     T 336   - 337   ,T 215
2061 1073     OUAD OR     FROM   C 346   - 350   ,T 501   ,T 501   ,C 350
2066 1078     OUAD OR     TO     T 431   - 434
2070 1080     A-ONE       FROM   C 214   - 214
2072 1082     A-ONE       TO     C 219   - 221   ,T 222   ,C 218
2076 1086     A-ONE       TO     C 501   - 505
2100 1088     ROM ADR.    TO     T 448   - 459   ,STORE ROM ADR: 1089
2102 1090     ROM ADR.    FROM   T 212   - 223
                             GO TO 896    RTN 1094
                             GO TO  1100  RTR 1092
```

```
2427 1303     COPY        TO     T 415  - 424
2431 1305     COPY        FROM   T 429  - 433
2433 1307     COPY        TO     T 425  - 433
2435 1309     A+B         FROM   T 401  - 409
2437 1311     A+B         TO     T 401  - 409
2441 1313     A+B         FROM   T 402  - 406  ,T 472  ,T 472
2445 1317     A+B         TO     T 402  - 404  ,T 473
2450 1320     A-B-ONE     FROM   T 402  - 405  ,C 511  ,C 473  ,C 473
2455 1325     A-B-ONE     TO     T 402  - 405
2457 1327     A-ONE       FROM   T 464  - 466
2461 1329     A-ONE       TO     T 464  - 466  ,C 222
2464 1332     OR          FROM   T 472  - 473
2466 1334     OR          TO     T 221  - 221
2470 1336     DECODER     FROM   T 221  - 222
2472 1338     DECODER     TO     T 213  - 213  ,T 221
2475 1341     COPY        FROM   T 213  - 213  ,T 213  ,T 213  ,T 511
,C 221
2503 1347     COPY        TO     T 216  - 220
2505 1349     ROM ADR.    FROM   T 212  - 223
                          GO TO  1280  LOOP OP NOT FINISHED
                          GO TO 512    LOOP OP FINISHED
                          GO TO 372    DECIMAL SUBSTRACT OP

              -(1352-1487) START OF TEST PROGRAM
              -START HERE WHEN TEST BUTTON PUSHED
              -INITIALIZE TO TEST
2510 1352       O.ECL.OR  TO     T 481  - 498
2512 1354       O.ECL.OR  TO     T 204  - 207  ,C 206
2515 1357       RELAYS    FROM   C 256  - 275
2517 1359       NOP
2520 1360       CONSTANT  TO     T 466  - 467
              ( 11    ) TO   T 468  - 475
              ( 1     ) TO   T 476  - 483
2524 1364       ROM ADR.  TO     T 499  - 510  ,STORE ROM ADR: 1365
2526 1366       ROM ADR.  FROM   T 467  - 478
                          GO TO 530    RTN 1368 TITLE SEARCH SUB

2530 1368       A+B       FROM   T 502  - 508  ,T 485  ,T 485
2534 1372       A+B       TO     T 502  - 506
2536 1374       ROM ADR.  FROM   T 499  - 510
                          GO TO  1376  LAST TEST OF PROGRAM NOT COMPLETED
                          GO TO  1472  LAST TEST OF PROGRAM COMPLETED

2540 1376       COPY      FROM   T 487  - 490
2542 1378       COPY      TO     T 448  - 451
2544 1380       COPY      FROM   T 256  - 263
2546 1382       COPY      TO     T 487  - 494
2550 1384       COPY      FROM   T 268  - 275
2552 1386       COPY      TO     T 452  - 459
2554 1388       O.ECL.OR  TO     T 477  - 484
2556 1390       ROM ADR.  TO     T 499  - 510  ,STORE ROM ADR: 1391
2560 1392       ROM ADR.  FROM   T 467  - 478
                          GO TO 530    TITLE SEARCH SUB

2562 1394       CONSTANT  TO     T 485  - 486
              ( 144   ) TO   T 487  - 494
              ( 302   ) TO   T 495  - 502
```

```
2566 1398     O.ECL.OR   TO      C 309   - 309
2570 1400     ROM ADR.   FROM    T 487   - 498
                         GO TO 612    REF GEN SET-UP SUB

2572 1402     O.ECL.OR   TO      T 465   - 484   ,C 466   ,C 469   ,C 474
,T 203
2600 1408     COPY       FROM    T 452   - 459
2602 1410     COPY       TO      T 487   - 494
2604 1412     ROM ADR.   TO      T 499   - 510   ,STORE ROM ADR: 1413
2606 1414     ROM ADR.   FROM    T 465   - 476
                         GO TO 530    RTN 1416 TITLE SEARCH SUB

2610 1416     O.ECL.OR   TO      T 155   - 185
2612 1418     M.M. ADV   FROM    T 155   - 162
2614 1420     O.ECL.OR   TO      T 0     - 30
2616 1422     O.ECL.OR   TO      T 31    - 61
2620 1424     Q.ECL.OR   TO      T 62    - 92
2622 1426     O.ECL.OR   TO      T 93    - 123
2624 1428     O.ECL.OR   TO      T 124   - 154
2626 1430     PIN DRV    FROM  T 1     - 30
2630 1432     COPY       FROM    T 448   - 451
2632 1434     COPY       TO      T 487   - 494   ,C 180
2635 1437     CONSTANT   TO      C 498   - 499
              ( 54   ) TO  C 500   - 507
2640 1440     Q.ECL.OR   TO      T 224   - 239
2642 1442     O.ECL.OR   TO      C 233   - 234
2644 1444     A-ONE      FROM    C 498   - 498
2646 1446     A-ONE      TO      T 240   - 243
2650 1448     ROM ADR.   FROM    T 224   - 235
                         GO TO  1536  IF ENTERED FROM 858 RTN 860 LOAD,
                                      WRITE OR TEST BUTTON NOT PUSHED,
                                      STOP ON FAIL
                                      876 CONTINUE ON FAIL
                                      464 LOAD, WRITE OR TEST BUTTON PUSHED
                                      IF ENTERED FROM 1448 RTN 1450

2652 1450     EXT.CONT   FROM    T 177   - 184
2654 1452     O.ECL.OR   TO      T 180   - 199   ,T 205
2657 1455     CONSTANT   TO      T 434   - 435
              ( 276  ) TO  T 436   - 443
              ( 5    ) TO  T 444   - 451
2663 1459     O.ECL.OR   TO      C 350   - 375
2665 1461     CONSTANT   TO      C 500   - 501
              ( 231  ) TO  C 502   - 509
2670 1464     FR.PANEL   FROM    C 437   - 440
2672 1466     ROM ADR.   FROM    C 437   - 448
                         GO TO MAIN MEMORY AS PROGRAM SOURCE

2676 1470     A-ONE      FROM    C 487   - 490
2700 1472     A-ONE      TO      C 487   - 490   ,T 509   ,T 484
2704 1476     CONSTANT   TO      T 499   - 500
              ( 124  ) TO  T 501   - 508
2707 1479     A-ONE      FROM    C 509   - 509
2711 1481     A-ONE      TO      C 504   - 506   ,T 505
2714 1484     EXT.CONT   FROM    T 499   - 502
2716 1486     ROM ADR.   FROM    T 499   - 510
                         GO TO 432    ALL TESTS COMPLETED
                         GO TO  1360  MORE TESTS TO BE DONE
```

```
                -(1488-1533) WALKING '1' AND '0'
2720  1488        CONSTANT   TO     T 218   - 219
                ( 342  ) TO   T 220   - 227
                ( 137  ) TO   T 228   - 235
                ( 24   ) TO   T 236   - 243
2725  1493        COPY       FROM   T 31    - 32
2727  1495        COPY       TO     C 291   - 291   ,C 32
2732  1498        A-ONE      FROM   C 33    - 36    ,T 32
2735  1501        A-ONE      TO     C 33    - 37
2737  1503        DECODER    FROM   T 32    - 36
2741  1505        DECODER    TO     T 0     - 15
2743  1507        DECODER    FROM   T 32    - 35    ,C 36
2746  1510        DECODER    TO     T 16    - 31
2750  1512        A-ONE      TO     C 280   - 285   ,T 501   ,C 447
2754  1516        M.MEM.     TO     T 304   - 327
2756  1518        ROM ADR.   FROM   T 280   - 291
                                GO TO MAIN MEMORY AS PROGRAM SOURCE
                                GO TO 1520  CONTINUE

2760  1520        DECODER    FROM   T 32    - 36
2762  1522        DECODER    TO     C 0     - 15
2764  1524        DECODER    FROM   T 32    - 35    ,C 36
2767  1527        DECODER    TO     C 16    - 24    ,C 447   ,C 31    ,C 291
2774  1532        ROM ADR.   FROM   T 280   - 291
                                GO TO MAIN MEMORY AS PROGRAM SOURCE

                -(1536-1551) TIME DELAY SUBROUTINE
                -MAX 8MS 30MS PER LOOP MAX 256 LOOPS
2776  1534        PIN DRV    FROM   T 1     - 30
3000  1536        Q.ECL.OR   TO     T 224   - 235
3002  1538        A-ONE      FROM   T 236   - 239
3004  1540        A-ONE      TO     T 236   - 239   ,T 233
3007  1543        A-ONE      FROM   T 240   - 243   ,T 233
3012  1546        A-ONE      TO     T 240   - 243   ,T 234   ,C 233
3016  1550        ROM ADR.   FROM   T 224   - 235
                                GO TO  512 END OF DELAY SUB
                                GO TO 1536 8MSEC DELAY SUB

                -(1552-1745) TRUTH TABLE AND TRUTH TABLE
                -MEMORY SUBROUTINE
3020  1552        CONSTANT   TO     T 314   - 315
                ( 0    ) TO   T 316   - 323
                ( 140  ) TO   T 324   - 331
3024  1556        M.MEM.     TO     T 296   - 319
3026  1558        M.M. ADV   FROM   C 121   - 128
3030  1560        COPY       FROM   C 199   - 199   ,T 199
3033  1563        COPY       TO     T 325   - 326
3035  1565        DECODER    FROM   C 102   - 102   ,C 325
3040  1568        DECODER    TO     T 323   - 324
3042  1570        O.ECL.OR   TO     C 283   - 284   ,C 287
3045  1573        ROM ADR.   FROM   T 320   - 331
                                GO TO  1576
                                GO TO  1584
                                GO TO  1600

3050  1576        O.ECL.OR   TO     T 325   - 330
3052  1578        M.M. ADV   FROM   T 323   - 330
3054  1580        M.MEM.     FROM   T 129   - 152
```

```
3056 1582    M.M. ADV   FROM  C 323  - 330
3060 1584    M.MEM.     TO    T 176  - 199
3062 1586    A-ONE      FROM  C 121  - 124
3064 1588    A-ONE      TO    C 121  - 124  ,C 199
3067 1591    A-ONE      FROM  C 125  - 128  ,C 199
3072 1594    A-ONE      TO    C 125  - 128
3074 1596    O.ECL.OR   TO    C 103  - 103  ,C 106  ,C 330
3100 1600    COPY       FROM  T 130  - 139
3102 1602    COPY       TO    T 129  - 138
3104 1604    COPY       FROM  T 140  - 149
3106 1606    COPY       TO    T 139  - 148
3110 1608    COPY       FROM  T 150  - 151  ,T 153
3113 1611    COPY       TO    T 149  - 151
3115 1613    COPY       FROM  T 154  - 163
3117 1615    COPY       TO    T 153  - 162
3121 1617    COPY       FROM  T 164  - 173
3123 1619    COPY       TO    T 163  - 172
3125 1621    COPY       FROM  T 174  - 183
3127 1623    COPY       TO    T 173  - 182
3131 1625    COPY       FROM  T 184  - 193
3133 1627    COPY       TO    T 183  - 192
3135 1629    COPY       FROM  T 194  - 198
3137 1631    COPY       TO    T 193  - 198
3141 1633    A-ONE      FROM  C 103  - 103
3143 1635    A-ONE      TO    C 103  - 103  ,T 199
3146 1638    A-ONE      FROM  C 104  - 107  ,C 199
3151 1641    A-ONE      TO    C 104  - 107  ,T 199
3154 1644    A-ONE      FROM  T 296  - 296
3156 1646    A-ONE      TO    T 296  - 296  ,T 332
3161 1649    A-ONE      FROM  T 297  - 300  ,C 332
3164 1652    A-ONE      TO    T 297  - 300  ,C 327
3167 1655    COPY       FROM  C 327  - 327  ,C 327
3172 1658    COPY       TO    T 323  - 326  ,C 329
3175 1661    ROM ADR.   FROM  T 320  - 331
                        GO TO  1560
                        GO TO  1664

3200 1664    A-B-ONE    FROM  T 312  - 315  ,C 511  ,T 121  ,T 122 .
,T 123  ,T 124
3207 1671    A-B-ONE    TO    T 332  - 335  ,T 320
3212 1674    A-B-ONE    FROM  T 316  - 320  ,T 125  ,T 126  ,T 127
,T 1
3220 1680    A-B-ONE    TO    T 336  - 340  ,T 320  ,C 331
3224 1684    M.M. ADV   FROM  C 332  - 339
3226 1686    ROM ADR.   FROM  T 320  - 331
                        GO TO  MM AS PROG SOURCE

3230 1688    OR         FROM  T 122  - 128
3232 1690    OR         TO    T 102  - 102
3234 1692    CONSTANT   TO    T 318  - 319
          ( 302 ) TO  T 320  - 327
3237 1895    A+B        FROM  T 332  - 335  ,C 511  ,C 511
3243 1699    A+B        TO    T 332  - 335  ,T 340
3246 1702    A+B        FROM  T 336  - 340
3250 1704    A+B        TO    T 332  - 335  ,C 331
3253 1707    DECODER    TO    C 224  - 243  ,T 233  ,T 235
3257 1711    NOP
```

```
3260 1712     ROM ADR.   TO     T 499  - 510   , STORE ROM ADR:  1713
3262 1714     ROM ADR.   FROM   T 224  - 235
                            GO TO  1534

3264 1716     O.ECL.OR   TO     C 1    - 24
3266 1718     PIN DRV    TO     T 506  - 536
3270 1720     O.ECL.OR   TO     C 281  - 282  , C 285  , T 511
3274 1724     ROM ADR.   FROM   T 320  - 331
                            GO TO MAIN MEMORY AS P.ROGRAM SOURCE
                            GO TO 1730

3276 1726     M.M. ADV   FROM   C 304  - 311
3300 1728     ROM ADR.   FROM   T 320  - 331
                            GO TO MAIN MEMORY AS PROGRAM SOURCE

3302 1730     CONSTANT   TO     T 150  - 151
          ( 276  ) TO   T 152  - 159
          ( 65   ) TO   T 160  - 167
          ( 371  ) TO   T 168  - 175
          ( 363  ) TO   T 176  - 183
          ( 5    ) TO   T 184  - 191
          ( 0    ) TO   T 192  - 199
3312 1738     M.M. ADV   FROM   T 192  - 199
3314 1740     M.MEM.     FROM   T 164  - 187
3316 1742     O.ECL.OR   TO     C 507  - 507
3320 1744     ROM ADR.   FROM   T 152  - 163
                            GO TO  1470  (NEXT TEST)

          -(1746-1761)  PRINT OUT "FAIL PIN ---"
3322 1746     CONSTANT   TO     T 292  - 293
          ( 352  ) TO   T 294  - 301
          ( 116  ) TO   T 302  - 309
          ( 2    ) TO   T 310  - 317
          ( 201  ) TO   T 318  - 325
          ( 114  ) TO   T 326  - 333
          ( 22   ) TO   T 334  - 341
          ( 30   ) TO   T 342  - 349
3333 1755     CONSTANT   TO     T 499  - 500
          ( 23   ) TO   T 501  - 508
3336 1758     ROM ADR.   TO     T 448  - 459  , STORE ROM ADR:  1759
3340 1760     ROM ADR.   FROM   T 499  - 510
                            GO TO  1100

          -(1762-1807)  PIN STATE PRINTOUT SUBROUTINE
3342 1762     CONSTANT   TO     T 230  - 231
          ( 344  ) TO   T 232  - 239
          ( 307  ) TO   T 240  - 247
          ( 140  ) TO   T 248  - 255
          ( 101  ) TO   T 256  - 263
          ( 5    ) TO   T 264  - 271
          ( 324  ) TO   T 272  - 279
          ( 304  ) TO   T 280  - 287
        ( 162  ) TO   T 288  - 295
3354 1772     ROM ADR.   TO     T 448  - 459  , STORE ROM ADR:  1773
3356 1774     ROM ADR.   FROM   T 284  - 295
                            GO TO  1836
```

```
3360 1776     CONSTANT   TO     T 230   - 231
          (  0     ) TO   T 232   - 239
          (  202   ) TO   T 240   - 247
          (  40    ) TO   T 248   - 255
          (  10    ) TO   T 256   - 263
          (  72    ) TO   T 264   - 271
          (  11    ) TO   T 272   - 279
          (  344   ) TO   T 280   - 287
          (  162   ) TO   T 288   - 295
3372 1786     ROM ADR.   TO     T 448   - 459   , STORE ROM ADR:  1787
3374 1788     ROM AOR.   FROM   T 284   - 295
                            GO TO  1838

3376 1790     CONSTANT   TO     T 230   - 231
        (  0     ) TO   T 232   - 239
          (  122   ) TO   T 240   - 247
          (  103   ) TO   T 248   - 255
          (  41    ) TO   T 256   - 263
      (  111   ) TO   T 264   - 271
          (  317   ) TO   T 272   - 279
          (  300   ) TO   T 280   - 287
          (  162   ) TO   T 288   - 295
3410 1800     A-ONE      FROM   C 460   - 460
3412 1802     A-ONE      TO     T 448   - 455   , C 456   , T 350
3416 1806     ROM ADR.   FROM   T 284   - 295
                            GO TO  1836  RTN  1810  CONTINUE ON FAIL
                           RTN 1812

          -( 1808-1834)  CHECK FOR V.I. PRINT OUT
          -TITLE SEARCH FOR PASS/FAIL INFORMATION
          -PRINT OUT
3420 1808     M.MEM.     TO     T 230   - 253
3422 1810     Q.ECL.OR   TO     T 461   - 461
3424 1812     A-ONE      TO     C 500   - 505
3426 1814     A-ONE      FROM   T 461   - 461
3430 1816     A-ONE      TO     C 501   - 501   , T 503   , T 507   , T 509
, T 510
3436 1822     COPY       FROM   C 487   - 490
3440 1824     COPY       TO     C 400   - 407
3442 1826     CONSTANT   TO     T 463   - 464
          (  22    ) TO   T 465   - 472
          (  42    ) TO   T 473   - 480
          (  360   ) TO   T 481   - 488
          (  377   ) TO   T 489   - 496
3450 1832     DECODER    TO     C 436   - 446
3452 1834     ROM ADR.   FROM   T 465   - 476
                            GO TO 530   RTN  1908
                            GO TO 2664  V-I  PRINT OUT

3454 1836     COPY       FROM   T 208   - 212
3456 1838     COPY       TO     C 404   - 412   , T 411   , C 204
3462 1842     ROM AOR.   TO     T 499   - 510   , STORE ROM ADR:  1843
3464 1844     COPY       FROM   T 1     - 10
3466 1846     COPY       TO     T 0     - 9
3470 1848     COPY       FROM   T 15    - 24
3472 1850     COPY       TO     T 16    - 24    , T 351
3475 1853     COPY       FROM   T 11    - 12    , T 0     , T 351   , T 13
, T 14
3503 1859     COPY       TO     T 10    - 15
```

```
          -(2048-2091) D/A INPUT OR OUTPUT INFO
          -SUBROUTINE FOR ONE PIN
4000 2048    D/A          FROM   T 286   - 293
4002 2050    EXT.CONT     TO     T 381   - 384
4004 2052    DECODER      FROM   T 379   - 379   ,C 384
4007 2055    DECODER      TO     C 381   - 381   ,T 382
4012 2058    COPY         FROM   T 382   - 382
4014 2060    COPY         TO     T 383   - 383
4016 2062    ROM ADR.     FROM   T 380   - 391
                             GO TO 2050  WAITING FOR 'READY' SIGNAL FROM D/A
                             GO TO 2064  WRITE DATA INTO D/A
                             GO TO 2078  READ DATA FROM D/A


          -TRANSFER INFORMATION TO D/A
4020 2064    D/A          TO     T 224   - 229
4022 2066    D/A          FROM   T 302   - 314
4024 2068    D/A          FROM   T 404   - 408
4026 2070    D/A          FROM   T 314   - 332
4030 2072    D/A          FROM   T 326   - 344
4032 2074    D/A          FROM   T 338   - 350
4034 2076    ROM ADR.     FROM   T 212   - 223
                             GO TO 512   FINISHED WRITING DATA INTO D/A


          -TRANSFER INFORMATION FROM D/A
4036 2078    D/A          TO     T 302   - 307
4040 2080    D/A          TO     T 302   - 314
4042 2082    D/A          TO     T 404   - 408
4044 2084    D/A          TO     T 314   - 332
4046 2086    D/A          TO     T 326   - 344
4050 2088    D/A          TO     T 338   - 350
4052 2090    ROM ADR.     FROM   T 212   - 223
                             GO TO 512   FINISHED READING DATA FROM D/A


          -(2092-2151) CONVERT BINARY DATA FROM D/A
          -TO DECIMAL INTERCHANGE DATA POSITION
4054 2092    COPY         FROM   T 231   - 240
4056 2094    COPY         TO     C 231   - 240
4060 2096    Q.ECL.OR     TO     C 410   - 410   ,C 412   ,C 415
4064 2100    A-ONE        FROM   C 240   - 240
4066 2102    A-ONE        TO     T 381   - 381   ,T 383   ,T 386
4072 2106    A-ONE        FROM   C 239   - 239
4074 2108    A-ONE        TO     T 385   - 385   ,T 387
4077 2111    COPY         FROM   T 238   - 238   ,T 237   ,T 236   ,T 235
,T 234   ,T 233   ,T 232   ,T 231
4110 2120    COPY         TO     T 389   - 396
4112 2122    COPY         FROM   T 233   - 234   ,T 511   ,T 233   ,T 232
,T 231
4120 2128    COPY         TO     T 419   - 433
4122 2130    COPY         FROM   T 457   - 466
4124 2132    COPY         TO     T 281   - 290
4126 2134    COPY         FROM   T 467   - 473
4130 2136    COPY         TO     T 291   - 297
4132 2138    ROM ADR.     TO     T 499   - 510   ,STORE ROM ADR: 2139
4134 2140    ROM ADR.     FROM   T 255   - 266
                             GO TO 390   RTN 2142
```

```
4136 2142    COPY        FROM  T 234  - 234  ,T 232  ,T 231
4142 2146    COPY        TO    T 419  - 421
4144 2148    ROM ADR.    TO    T 499  - 510  ,STORE ROM ADR: 2149
4146 2150    ROM ADR.    FROM  T 255  - 266
                            GO TO 390   RTN 2152


          -(2152-2191) MULTIPLIER PRDGRAMMABLE
          -THRU 448          -455
4150 2152    COPY        FROM  T 381  - 390
4152 2154    COPY        TO    T 231  - 240
4154 2156    COPY        FROM  T 391  - 399
4156 2158    COPY        TO    T 241  - 249
4160 2160    O.ECL.OR    TO    T 381  - 404
4182 2162    A-ONE       FROM  T 448  - 451
4164 2164    A-ONE       TO    T 448  - 451  ,T 456
4167 2167    A-ONE       FROM  T 452  - 456
4171 2169    A-ONE       TO    T 452  - 455
4173 2171    OR          FROM  T 448  - 455
4175 2173    OR          TO    T 500  - 500
4177 2175    A-ONE       FROM  C 500  - 500
4201 2177    A-ONE       TO    T 502  - 507  ,C 501  ,C 502  ,T 503
42062182     COPY        FROM  T 231  - 240
4210 2184    COPY        TO    T 410  - 419
4212 2186    COPY        FROM  T 241  - 249
4214 2188    COPY        TO    T 420  - 433
4216 2190    ROM ADR.    FROM  T 255  - 266
                            GO TO 390   RTN 2162
                            GO TO 2192

4220 2192    ROM ADR.    FROM  T 267  - 278
                            GO TO 2330
                            GO TO 2338
                            GO TO 2346

          -(2194-2328) READ SET UP DATA FROM D/A
          -SELECTS ONE OF              -I +I              -V +V
          -REPLACE NON CONTINUOUS OPPOSITE I WITH O
4222 2194    COPY        FROM  T 381  - 390
4224 2196    COPY        TO    T 465  - 474
4226 2198    COPY        FROM  T 395  - 402
4230 2200    COPY        TO    T 479  - 486
4232 2202    COPY        FROM  T 425  - 430
4234 2204    COPY        TO    T 457  - 463
4236 2206    COPY        FROM  T 493  - 497
4240 2208    COPY        TO    C 289  - 293
4242 2210    DECODER     TO    T 379  - 390  ,C 391  ,C 287
4248 2214    ROM ADR.    TO    T 499  - 510  ,STORE ROM ADR: 2215
4250 2216    ROM ADR.    FROM  T 380  - 391
                            GO TO 2048  RTN 2218

4252 2218    DECODER     TO    T 290  - 301
4254 2220    CONSTANT    TO    T 214  - 215
          ( 70   ) TO    T 216  - 223
4257 2223    OUAD OR     FROM  T 392  - 392  ,T 406  ,C 406
4263 2227    OUAD OR     TO    T 406  - 406  ,T 484
4266 2230    O.ECL.OR    FROM  C 406  - 406  ,T 394
4271 2233    Q.ECL.OR    TO    T 394  - 394
```

```
4273 2235     DECODER     FROM   C 392  - 393
4275 2237     DECODER     TO     T 388  - 390
4277 2239     DECODER     FROM   T 392  - 394
4301 2241     DECODER     TO     T 381  - 387
4303 2243     AND OR      FROM   T 407  - 407  ,T 383  ,T 387  ,T 387
4310 2248     AND OR      TO     T 386  - 386
4312 2250     AND OR      FROM   C 404  - 404  ,T 381  ,T 385  ,T 385
4317 2255     AND OR      TO     T 385  - 385
4321 2257     QUAD OR     FROM   T 385  - 386  ,T 385  ,T 390
4325 2261     QUAD OR     TO     T 432  - 433  ,C 431
4330 2264     OR          FROM   T 432  - 433  ,T 388
4333 2267     OR          TO     C 434  - 434
4335 2269     NOP
4336 2270     ROM ADR.    TO     T 499  - 510  ,STORE ROM ADR: 2271
4340 2272     ROM ADR.    FROM   T 212  - 223
                             GO TO 896   RTN 2274

4342 2274     CONSTANT    TO     T 253  - 254
              ( 206 ) TO  T 255  - 262
              ( 241 ) TO  T 263  - 270
              ( 221 ) TO  T 271  - 278
4347 2279     AND OR      FROM   T 408  - 408  ,T 386  ,C 405  ,T 385
4354 2284     AND OR      TO     T 271  - 271
4356 2286     DECODER     FROM   C 392  - 392  ,T 241  ,T 271
4362 2290     DECODER     TO     T 448  - 449
4364 2292     DECODER     FROM   C 241  - 241  ,T 271
4367 2295     DECODER     TO     T 450  - 452  ,C 270
4372 2298     QUAD OR     FROM   T 271  - 271  ,T 392  ,T 271  ,T 392
4377 2303     QUAD OR     TO     C 271  - 271  ,T 272
4402 2306     O.ECL.OR    TO     T 451  - 455
4404 2308     AND OR      FROM   C 392  - 392  ,T 241  ,C 270  ,C 270
4411 2313     AND OR      TO     T 452  - 452
4413 2315     O.ECL.OR    TO     T 381  - 404
4415 2317     O.ECL.OR    TO     T 410  - 428
4417 2319     CONSTANT    TO     T 499  - 500
              ( 13  ) TO  T 501  - 508
4422 2322     A+B         FROM   T 502  - 505  ,T 230
4425 2325     A+B         TO     T 502  - 505
4427 2327     ROM ADR.    FROM   T 499  - 510
                             GO TO 2092
                             GO TO 2100

              -4 BIT SHIFT REGISTER
              -DIV 10 EACH
              -4 BIT SHIFT REGISTER
              -DIV 10
              -DIV 1
4432 2330     COPY        FROM   T 385  - 394
4434 2332     COPY        TO     T 381  - 390
4436 2334     COPY        FROM   T 395  - 404
4440 2336     COPY        TO     T 391  - 404
4442 2338     COPY        FROM   T 385  - 394
4444 2340     COPY        TO     T 381  - 390
4446 2342     COPY        FROM   T 395  - 404
4450 2344     COPY        TO     T 391  - 404
4452 2346     COPY        FROM   C 281  - 287
4454 2348     COPY        TO     C 500  - 507
```

```
4456 2350     ROM ADR.   FROM   T 212   - 223
                            GO TO 512   RTN 2364
                                                2376
                                                2414

          -(2352-2522) STATE AND V.I.
          -PIN SET UP PRINT OUT
4460 2352     CONSTANT   TO     T 413   - 414
          ( 64    ) TO   T 415   - 422
          ( 161   ) TO   T 423   - 430
4464 2356     COPY       FROM   T 511   - 511   ,T 511   ,C 492
4470 2360     COPY       TO     T 392   - 394
4472 2362     ROM ADR.   FROM   T 416   - 427
                            GO TO 2202  READ IN -I RTN 2364

4474 2364     COPY       FROM   T 391   - 394   ,T 492
4477 2367     COPY       TO     T 475   - 478   ,T 394
4502 2370     DECODER    TO     C 392   - 393
4504 2372     CONSTANT   TO     T 413   - 414
          ( 111   ) TO   T 415   - 422
          ( 214   ) TO   T 423   - 430
4510 2376     ROM ADR.   FROM   T 414   - 425
                            GO TO 2194  READ IN +I RTN 2378

4512 2378     COPY       FROM   T 289   - 297
4514 2380     COPY       TO     C 410   - 418
4516 2382     COPY       FROM   T 474   - 476
4520 2384     COPY       TO     C 419   - 421
4522 2386     COPY       FROM   T 477   - 486
4524 2388     COPY       TO     C 422   - 433
4526 2390     CONSTANT   TO     T 228   - 229
          ( 204   ) TO   T 230   - 237
          ( 1     ) TO   T 238   - 245
4532 2394     ROM ADR.   TO     T 499   - 510   ,STORE ROM ADR: 2395
4534 2396     ROM ADR.   FROM   T 230   - 241
                            GO TO 388

          -GO TO DEC SUBTRACT
                       -(+I) (-I)
4536 2398     COPY       FROM   T 391   - 394   ,T 434   ,T 492
4542 2402     COPY       TO     T 475   - 478   ,T 491   ,T 393   ,C 392   ,T
 394
4550 2408     CONSTANT   TO     T 413   - 414
          ( 111   ) TO   T 415   - 422
          ( 324   ) TO   T 423   - 430
4554 2412     ROM ADR.   FROM   T 414   - 425
                            GO TO 2194  READ + OR - V

4556 2414     COPY       FROM   T 289   - 297
4560 2416     COPY       TO     T 465   - 473
4562 2418     COPY       FROM   T 397   - 403   ,C 230
4565 2421     COPY       TO     T 401   - 408
4567 2423     NOP
4570 2424     CONSTANT   TO     T 417   - 418
          ( 224   ) TO   T 419   - 426
          ( 364   ) TO   T 427   - 434
4574 2428     ROM ADR.   TO     T 499   - 510   ,STORE ROM ADR: 2429
4576 2430     ROM ADR.   FROM   T 417   - 428
                            GO TO 592   LOAD BLANK IN PRINT OUT FIELD
```

```
4600 2432    DECODER   TO    C 397  - 400  ,T 301  ,C 294
4604 2436    DECODER   FROM  T 351  - 351  ,C 204
4607 2439    DECODER   TO    T 409  - 410
4611 2441    CONSTANT  TO    C 500  - 501
          ( 275  ) TO  C 502  - 509
4614 2444    ROM ADR.  TO    T 412  - 423  ,STORE ROM ADR: 2445
4616 2446    ROM ADR.  FROM  T 212  - 223
                       GO TO 512   THEN 2586 RTN 2448
                                  (FORMAT FOR V PRINTOUT)

4620 2448    COPY      FROM  C 465  - 474
4622 2450    COPY      TO    C 381  - 396  ,C 235  ,C 294
4626 2454    NOP
4627 2455    COPY      FROM  T 475  - 476  ,C 491  ,T 410
4633 2459    COPY      TO    T 391  - 392  ,T 408  ,T 409  ,T 393
4640 2464    COPY      FROM  T 477  - 486
4642 2466    COPY      TO    T 397  - 407
4644 2468    DECODER   TO    T 429  - 430  ,T 277
4647 2471    CONSTANT  TO    C 500  - 501
          ( 275  ) TO  C 502  - 509
4652 2474    ROM ADR.  TO    T 412  - 423  ,STORE ROM ADR: 2475
4654 2476    ROM ADR.  FROM  T 212  - 223
                       GO TO 512   THEN 2586(FORMAT FOR I PRINTOUT)

          -(2478-2496) FORMAT FOR I PRINTER
          -CONVERT PIN NUMBER FROM B INTO DECIMAL
          -USING DECIMAL ADDER
4656 2478    COPY      FROM  T 435  - 439
4660 2480    COPY            TO    T 381  - 404
4662 2482    COPY      FROM  T 439  - 439  ,T 439
4665 2485    COPY        TO    T 411  - 433  ,C 410
4670 2488    A-ONE     TO    T 291  - 295
4672 2490    CONSTANT  TO    T 462  - 463
          ( 206  ) TO  T 464  -471
          ( 1    ) TO  T 472  - 479
 4771111
          ( 1    ) TO  T 472  - 479
4676 2494    ROM ADR.  TO    T 499  - 510  ,STORE ROM ADR: 2495
4700 2496    ROM ADR.  FROM  T 464  - 475
                       GO TO 390

          -CONVERT DECIMAL TO 6 BIT ASCII
          -SURPRESS LEADING ZERO SET UP 'I'
4702 2498    COPY      FROM  T 381  - 386
4704 2500    COPY      TO    T 338  - 341  ,T 344  ,T 345  ,C 342
4711 2505    OR        FROM  T 344  - 347
4713 2507    OR        TO    T 348  - 348
4715 2509    A-ONE     TO    T 236  - 241  ,T 237  ,C 230  ,T 293
4722 2514    COPY      FROM  T 440  - 446
4724 2516    COPY      TO    T 500  - 507  ,C 508  ,C 391  ,C 203
4731 2521    ROM ADR.  FROM  T 212  - 223
                       GO TO 512

4734 2524    O.ECL.OR  TO    C 326  - 349
4736 2526    PIN DRV   TO    T 319  - 349
4740 2528    CONSTANT  TO    C 500  - 501
          ( 210  ) TO  C 502  - 509
```

```
4743 2531     NOP
              -(2532-2564) SELECTS LOGIC DATA FOR
              -PRINT OUT
4744 2532     COPY        FROM   C 493  - 497
4746 2534     COPY        TO     C 319  - 324
4750 2536     A-ONE       FROM   T 320  - 323  ,T 319
4753 2539     A-ONE       TO     T 320  - 323  ,T 223
4756 2542     COPY        FROM   T 326  - 330  ,T 319  ,T 223
4762 2546     COPY        TO     T 325  - 329  ,C 319  ,T 215
4766 2550     COPY        FROM   T 331  - 340
4770 2552     COPY        TO     T 330  - 339
4772 2554     COPY        FROM   T 341  - 349  ,T 325
4775 2557     COPY        TO     T 340  - 349
4777 2559     A-ONE       FROM   C 223  - 223
5001 2561     A-ONE       TO     T 217  - 222
5003 2563     ROM ADR.    FROM   T 212  - 223
                             GO TO 2542
                             GO TO 512

5006 2566     DECODER     FROM   C 408  - 409  ,C 203
5011 2569     DECODER     TO     T 381  - 382
5013 2571     DECODER     FROM   T 408  - 409
5015 2573     DECODER     TO     C 383  - 384  ,T 294
5020 2576     COPY        FROM   T 408  - 408  ,T 383  ,C 408
5024 2580     COPY        TO     T 381  - 381  ,T 384  ,C 429  ,T 408
,C 430
              -(2586-2663) FORMATTER OF VI PRINT OUT
              -1ST PASS V TRUNCATE AND JUSTIFY
              -2ND PASS I TRUNCATE AND JUSTIFY
5032 2586     COPY        FROM   T 381  - 384
5034 2588     COPY        TO     T 290  - 293
5036 2590     COPY        FROM   T 385  - 394
5040 2592     COPY        TO     T 381  - 390
5042 2594     COPY        FROM   T 395  - 404
5044 2596     COPY        TO     T 391  - 400
5046 2598     COPY        FROM   T 405  - 407
5050 2600     COPY        TO     T 401  - 407
5052 2602     DECODER     FROM   C 291  - 292  ,T 293  ,T 290
5056 2606     DECODER     TO     T 424  - 428
5060 2608     AND OR      FROM   C 427  - 428  ,C 294  ,C 294  ,C 412
,C 412
5066 2614     AND OR      TO     C 412  - 412
5070 2616     OR          FROM   T 396  - 402  ,T 412
5073 2619     OR          TO     T 412  - 412
5075 2621     AND OR      FROM   T 428  - 430  ,C 294
5100 2624     AND OR      TO     C 294  - 294
5102 2626     OR          FROM   T 381  - 388
5104 2628     OR          TO     T 427  - 427
5106 2630     O.ECL.OR    TO     C 219  - 220
5110 2632     ROM ADR.    TO     T 499  - 510  ,STORE ROM ADR: 2633
5112 2634     ROM ADR.    FROM   T 212  - 223
                             GO TO 896

5114 2636     OR          FROM   T 390  - 394  ,T 427  ,T 428  ,C 429
5121 2641     OR          TO     T 503  - 503
5123 2643     COPY        FROM   T 502  - 503  ,C 337  ,C 337  ,T 412
```

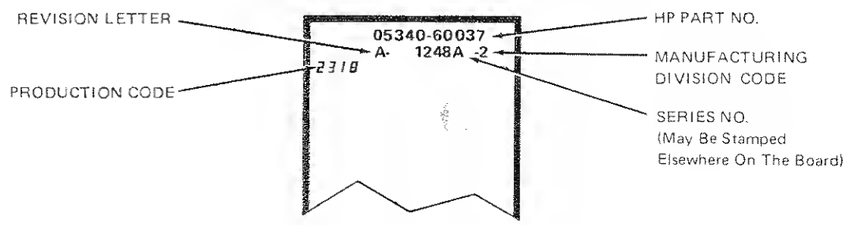
```
5374 2812     DECODER    TO     T 379  - 390
5376 2814     ROM ADR.   TO     T 499  - 510   ,STORE ROM ADR: 2815
5400 2816     ROM ADR.   FROM   T 380  - 391
                            GO TO 2048

              -LOGIC TO CONTROL V OR I
              -MANIPULATION AND RETURN CONTROL
5402 2818     CONSTANT   TO     T 460  - 461
            ( 200  ) TO   T 462  - 469
            ( 243  ) TO   T 470  - 477
            ( 56   ) TO   T 478  - 485
5407 2823     AND OR     FROM   C 204  - 204   ,T 376
5412 2826     AND OR     TO     T 505  - 505
5414 2828     A-ONE      TO     C 499  - 504   ,C 414
5417 2831     O.ECL.OR   FROM   T 351  - 351   ,T 461
5422 2834     O.ECL.OR   TO     T 378  - 390   ,C 431
5425 2837     AND OR     FROM   C 406  - 406   ,T 351
5430 2840     AND OR     TO     T 440  - 446
5432 2842     O.ECL.OR   FROM   C 509  - 511   ,T 351   ,T 492   ,T 440
5437 2847     O.ECL.OR   TO     C 441  - 445
5441 2849     COPY       FROM   T 493  - 497   ,C 406   ,T 204   ,T 505
,T 351
5447 2855     COPY       TO     C 289  - 293   ,T 288   ,C 500   ,C 507
,T 376   ,C 465
5456 2862     COPY       FROM   T 442  - 444
5460 2864     COPY       TO     T 432  - 434
5462 2866     ROM ADR.   FROM   T 380  - 391
                            GO TO 2048  RTN 2678 FINISHED PIN INFO PRINTOUT
                                        RTN 2870 GO TO VI TWEEK
                                        RTN 2868 TERMINATE PRINTOUT

5464 2868     ROM ADR.   FROM   T 461  - 472
                            GO TO  1808

5466 2870     O.ECL.OR   TO     T 465  - 465
5470 2872     ROM ADR.   FROM   T 462  - 473
                            GO TO 896   SELECT REF LEVEL TO BE ADJUSTED

5472 2874     AND OR     FROM   T 442  - 444   ,C 278
5475 2877     AND OR     TO     T 417  - 417
5477 2879     O.ECL.OR   FROM   T 378  - 378   ,T 492
5502 2882     O.ECL.OR   TO     C 418  - 420   ,T 419   ,T 434
5506 2886     ROM ADR.   TO     T 499  - 510   ,STORE ROM ADR: 2887
5510 2888     ROM ADR.   FROM   T 474  - 485
                            GO TO 746   (A+/-1) (A+/-16) B

            -(2890-2833) PRESET RANGE LIMITS
5512 2890     DECODER    FROM   C 442  - 442
5514 2892     DECODER    TO     C 502  - 504   ,C 416
5517 2895     NOP
5520 2896     O.ECL.OR   FROM   C 415  - 418   ,T 289
5523 2899     O.ECL.OR   TO     T 431  - 433
5525 2901     CONSTANT   TO     T 228  - 229
            ( 175  ) TO   T 230  - 237
            ( 31   ) TO   T 238  - 245
            ( 126  ) TO   T 246  - 253
            ( 103  ) TO   T 254  - 261
            ( 22   ) TO   T 262  - 269
            ( 0    ) TO   T 270  - 277
```

```
5535 2909     CONSTANT   TO     T 300   - 301
            ( 175    ) TO   T 302   - 309
            ( 21     ) TO   T 310   - 317
            ( 126    ) TO   T 318   - 325
            ( 203    ) TO   T 326   - 333
            ( 23     ) TO   T 334   - 341
            ( 276    ) TO   T 342   - 349
5545 2917     AND OR     FROM   C 441   - 443   ,T 408   ,T 443   ,C 405
5552 2922     AND OR     TO     T 434   - 434
5554 2924     ROM ADR.   FROM   T 212   - 223
                            GO TO 512    THEN 2926 SPECIAL V SET-UP
                                         RTN 2934

5556 2926     CONSTANT   TO     C 306   - 307
            ( 261    ) TO   C 308   - 315
            ( 105    ) TO   C 316   - 323
            ( 22     ) TO   C 324   - 331
5563 2931     DECODER    TO     T 303   - 304   ,T 338
5566 2934     Q.ECL.OR   FROM   T 432   - 434   ,T 433   ,C 418
5572 2938     O.ECL.OR   TO     C 429   - 430   ,C 203
5575 2941     QUAD OR    FROM   C 429   - 432
5577 2943     QUAD OR    TO     T 448   - 448   ,T 418   ,T 420   ,C 441
5604 2948     ROM ADR.   TO     T 499   - 510   ,STORE ROM ADR: 2949
5606 2950     ROM ADR.   FROM   T 462   - 473
                            GO TO 896    SELECT CORRECT RANGE LIMIT

5610 2952     Q.ECL.OR   TO     T 433   - 433
5612 2954     ROM ADR.   FROM   T 474   - 485
                            GO TO 746    COMPARE (A+B), (A-B) A

          -(2956-2975) COMPARE RANGE LIMIT
          -WITH ADJUST V OR I
5614 2956     DECODER    TO     T 431   - 434
5616 2958     O.ECL.OR   FROM   T 284   - 284   ,C 418   ,T 430   ,C 418
,C 418
5624 2964     Q.ECL.OR   TO     C 449   - 449   ,C 416   ,T 433
5630 2968     ROM ADR.   TO     T 499   - 510   ,STORE ROM ADR: 2969
5632 2970     ROM ADR.   FROM   T 462   - 473
                            GO TO 896    RTN 2972

5634 972    O.ECL.OR  TO     T 414   - 414
5636 2974     ROM ADR.   FROM   T 462   - 473
                            GO TO 896    RTN 2976

5640 2976     DECODER    FROM   T 448   - 449   ,T 416
5643 2979     DECODER    TO     T 204   - 204   ,C 434
5646 2982     COPY       FROM   T 392   - 392
5650 2984     COPY       TO     C 419   - 420
5652 2986     ROM ADR.   TO     T 499   - 510   ,STORE ROM ADR: 2987
5654 2988     ROM ADR.   FROM   T 474   - 485
                            GO TO 746    PRESET B,A,AB

5656 2990     COPY       FROM   T 441   - 444   ,T 434   ,T 416
5662 2994     COPY       TO     T 431   - 434   ,T 444   ,C 222
5666 2998     DECODER    FROM   T 443   - 444   ,C 289
5671 3001     DECODER    TO     T 419   - 420
5673 3003     O.ECL.OR   TO     C 236   - 243
```

SYMBOLS

DANGEROUS VOLTAGE, EXCEEDS 1000 VOLTS
FRONT PANEL LABEL
REAR PANEL LABEL
INTERIOR AND PC BOARDS LABEL
WIPER MOVES TOWARD "CW" WHEN CONTROL IS ROTATED CLOCKWISE
PROTECTIVE CONDUCTOR TERMINAL
CIRCUIT COMMON
IDENTIFIED COMMON
CHASSIS TERMINAL
KNOB CONTROL
SCREWDRIVER ADJUST
MAIN SIGNAL PATH
FEEDBACK PATH
TEST POINT
INSTRUCTION MANUAL REFERENCE
ALTERNATING CURRENT
DIRECT CURRENT
ALTERNATING OR DIRECT CURRENT

PRINTED CIRCUIT BOARD IDENTIFICATION



REFERENCE DESIGNATIONS

REFERENCE DESIGNATIONS WITHIN ASSEMBLIES ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION. JACKS ARE THE STATIONARY CONNECTORS AND PLUGS ARE THE MORE MOVEABLE OF TWO CONNECTORS.

ASSEMBLY	ABBREVIATION	COMPLETE DESCRIPTION
A25	C1	A25C1
A25A1	CR1	A25A1CR1
NO PREFIX	J3	J3

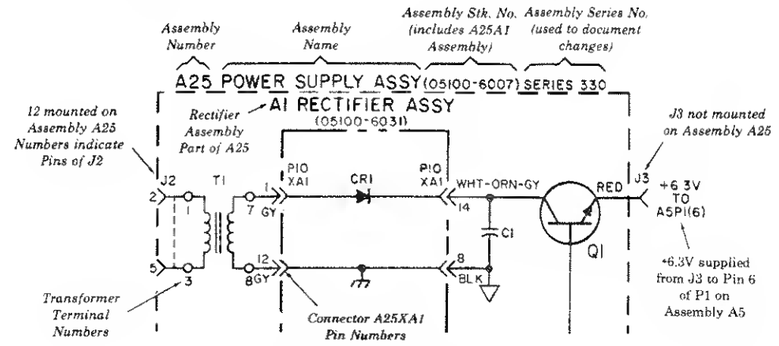


Figure 8-9. Schematic Diagram Notes

8-164. The two main program sources (ROM and Main Memory) control the flow of serial data to and from those blocks located on the left of the block diagram. For example, data needed to test an IC can flow from the Magnetic Card Reader through the RAM where it is formatted and routed to the Main Memory. It can then be sent, via the RAM, to the ALU (Arithmetic Unit), which helps simulate, for reference purposes, the IC under test. Other data passes to the Reference Voltage Generator and Control block. This block converts the data from a binary code into four lines of reference levels that are strobed to the Pin Drivers. The Pin Drivers are responsible for driving the test socket pins with the correct voltages and currents.

8-165. The Memories

8-166. Of major importance are the three memories that control the tester's operation. These are the ROM, the Main Memory, and the RAM. These memories are described in the following paragraphs.

8-167. THE ROM. The ROM (Read Only Memory) contains 36,864 bits (3072 x 12) of fixed information. This memory stores the tester's basic operating routine. It allows the tester to follow a given procedure but with the ability to vary its algorithm in accordance with the result of the completed operation and the front panel switch positions. It can also relinquish control to other portions of the tester (e.g., the Main Memory). The ROM controls the tester's operation by way 12 Program Control lines (described later).

8-168. Notice that selection of the ROM program codes (12 lines) is controlled by the ROM Address Register. The Address Register provides 12 address lines to the ROM that enable specific locations (or addresses) within the ROM. The ROM will then output the data contained in the addressed location. The address code can be sequentially advanced by pulsing the Program Advance line, or it can be radically changed (as in a "go-to" statement by enabling the Transfer line and serially clocking in a new address from the RAM. (It must be noted that any information contained in the RAM originated from some other source.) The 11th and 12th lines from the ROM Address Register control whether the program source is the ROM or the Main Memory when both lines are true (11).

8-169. THE MAIN MEMORY. The Main Memory contains up to 6144 bits of information that is taken from the magnetic program card. Therefore, this memory contains information pertaining to the testing of a specific IC plus the PASS/FAIL count. Basically, there are four types of information stored in this memory:

1. *Header* information, which is the IC number and the type of test (pass/fail or diagnostic).

2. The *Setup Data* for the IC to be tested, i.e., the codes for the voltages and currents that will be applied to the IC under test.

3. The *Logic Model* program, i.e., the information that will simulate a logic function and generate a stimulus to that function. This produces a reference to which the device under test can be compared.

4. The *Test Sequence* information. This combines 2 and 3 into a specific test. Also, the Main Memory initially stores the check-sum number at the end of the card. If the number of bits transferred from the card agrees with this number, the number is replaced with Pass/Fail storage locations, i.e., locations that hold numbers representing the number of IC's that passed or failed their tests. If the check-sum number does not agree with the counted bits from the card, the word "RELOAD" is printed out.

8-170. These four types of information are serially transferred from the magnetic program card (three bits at a time) and stored in the Main Memory in words that are 24 bits long. Once all the information is stored, it can be removed serially as data to the RAM or as parallel 12-bit words to the Program Control lines.

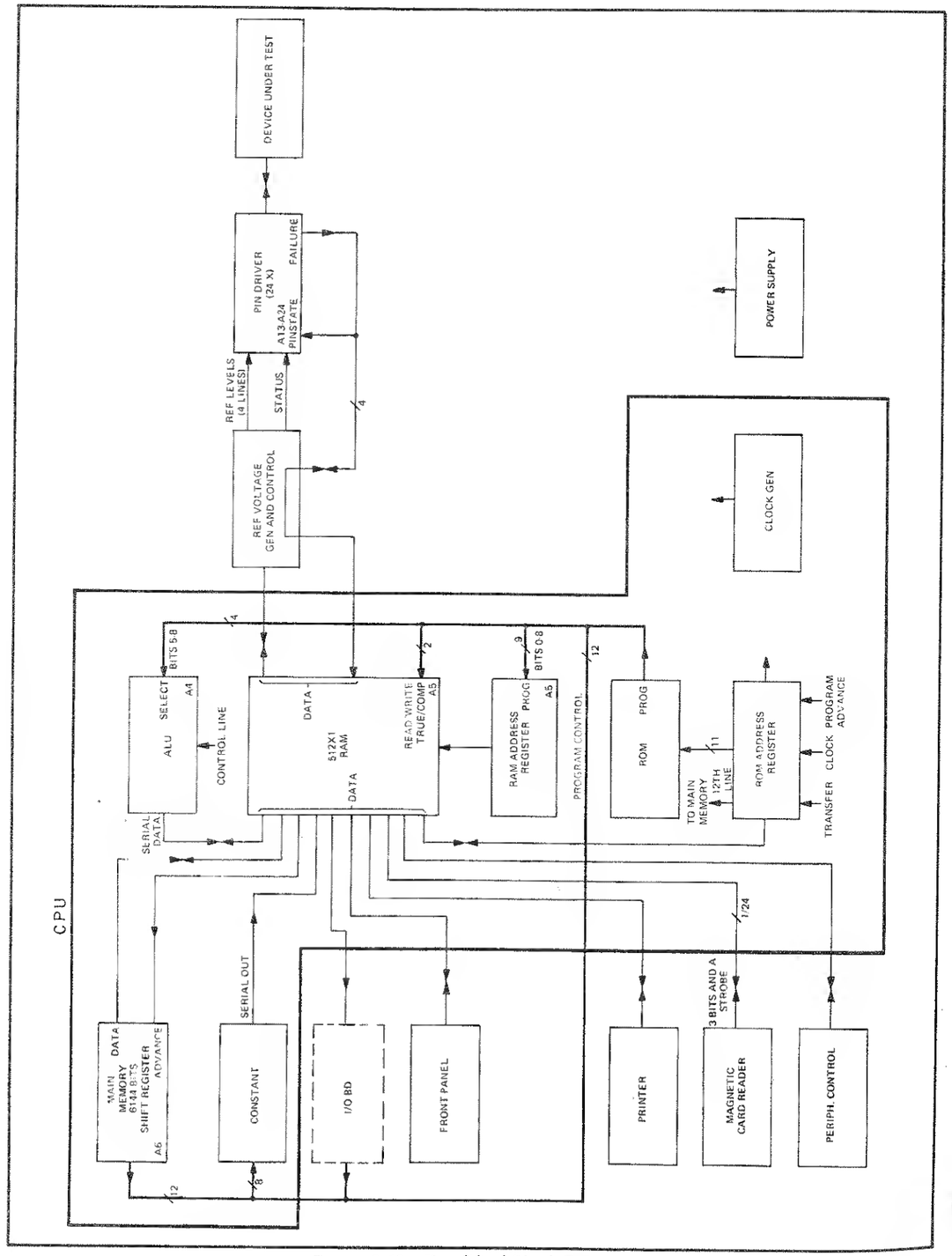


Figure 8-10. Simplified Block Diagram

8-171. During the testing of an IC, the ROM relinquishes program control to the Main Memory's logic Model program. This allows the tester to *simulate* the device under test (a model) and to apply a stimulus pattern to the model. This information is then stored in the RAM for access by the ROM program and is then applied to the actual device under test.

8-172. THE RAM. As previously mentioned, any exchange of data between blocks is accomplished serially and by way of the RAM. The storage capacity of this device is 512 bits long by one-bit wide (512 x 1); expressed differently, there are 512 data locations, each having the capacity of storing one bit of data. This data is stored and retrieved by addressing the RAM Address Register with the nine least-significant bits of the Program Control lines. This method is referred to as *presetting*. Once preset, however, the address code can be sequentially advanced by clocking the register (for example, if the data word is more than one-bit long). Although described later in more detail, it should be noted that before the RAM is addressed with a RAM Address code, the Processor Memory must first receive another 12-bit code that designates certain operations and functions to be performed within the tester.

8-173. Included in this first code is the number of data bits to be automatically transferred to or from the RAM. The subsequent RAM Address code specifies the starting location (presetting) after which, the addresses are automatically and sequentially stepped through until the specified number of bits have been transferred. At this point, additional RAM Address codes may be used to address individual locations within the RAM, one at a time and at specified locations. The tester, however, is still under control of the first 12-bit word that specifies the transmitter or receiver of data.

8-174. Figure 8-11 shows the RAM and the particular blocks associated with data transfer. Note that some blocks are strictly senders of data, while others are receivers of data, and still others are bidirectional. Again, none of the blocks can exchange data directly between themselves — data must go from one block, through the RAM and then to the second block.

8-175. THE ALU. The block located immediately above the RAM (Figure 8-10) represents the tester's ALU (Arithmetic Logic Unit). The ALU functions as a decision-making block as the CPU steps through its algorithm. It also serves as a logic model simulator. This section, which can be viewed as a group of "building blocks", performs either logic functions or arithmetic operations, as determined by a control line. Once the operating mode has been established, four of the Program Control lines (bits 5-8) select the actual function to be performed. For example, assume the control line has chosen a Logic Function operation. The four-line code, then must select the *specific* function to be performed — for example, an eight input OR gate, an Exclusive OR, or perhaps a D type flip-flop. Selection of the logic function is in accordance with the device under test and is accomplished by arranging the "building blocks" so they can simulate a logic function.

8-176. Input data is needed, however, for the ALU to actually perform an operation. If no input data is specified, the data inputs are initialized to zero. In the case of the eight-input OR gate, assume that one of the input pins is in the "1" state. The output, then, is also a "1".

8-177. Notice that this setup data (i.e., the stimulus for the model) enters the ALU serially — it is internally converted to parallel and placed across the OR gate's inputs. The resultant data (the "1" state output from the model OR gate) uses this same block diagram line when it is sent to the RAM for storage.

8-178. Each of the first 24 bits in the RAM contains one bit of information that relates to the same pin of the device under test, e.g., RAM address 6 relates to pin 6 of the device. These first 24 bits select the appropriate logic state applied to the device. The logic states are stored in each pin driver and will be described later. The "1" state output of the OR logic model, then, takes its proper place in the RAM to help determine what the device's output should be.

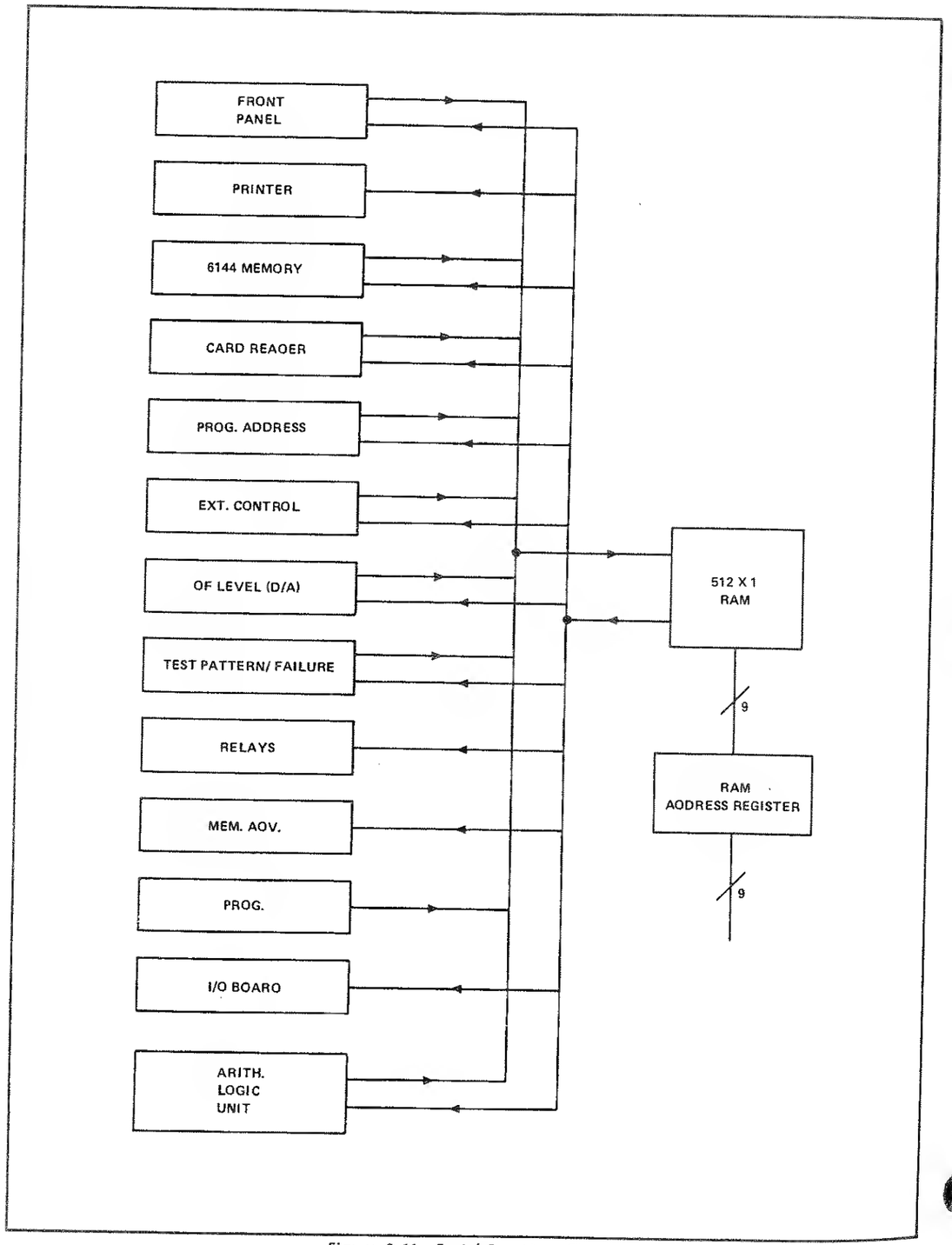


Figure 8-11. Serial Bus Data Flow

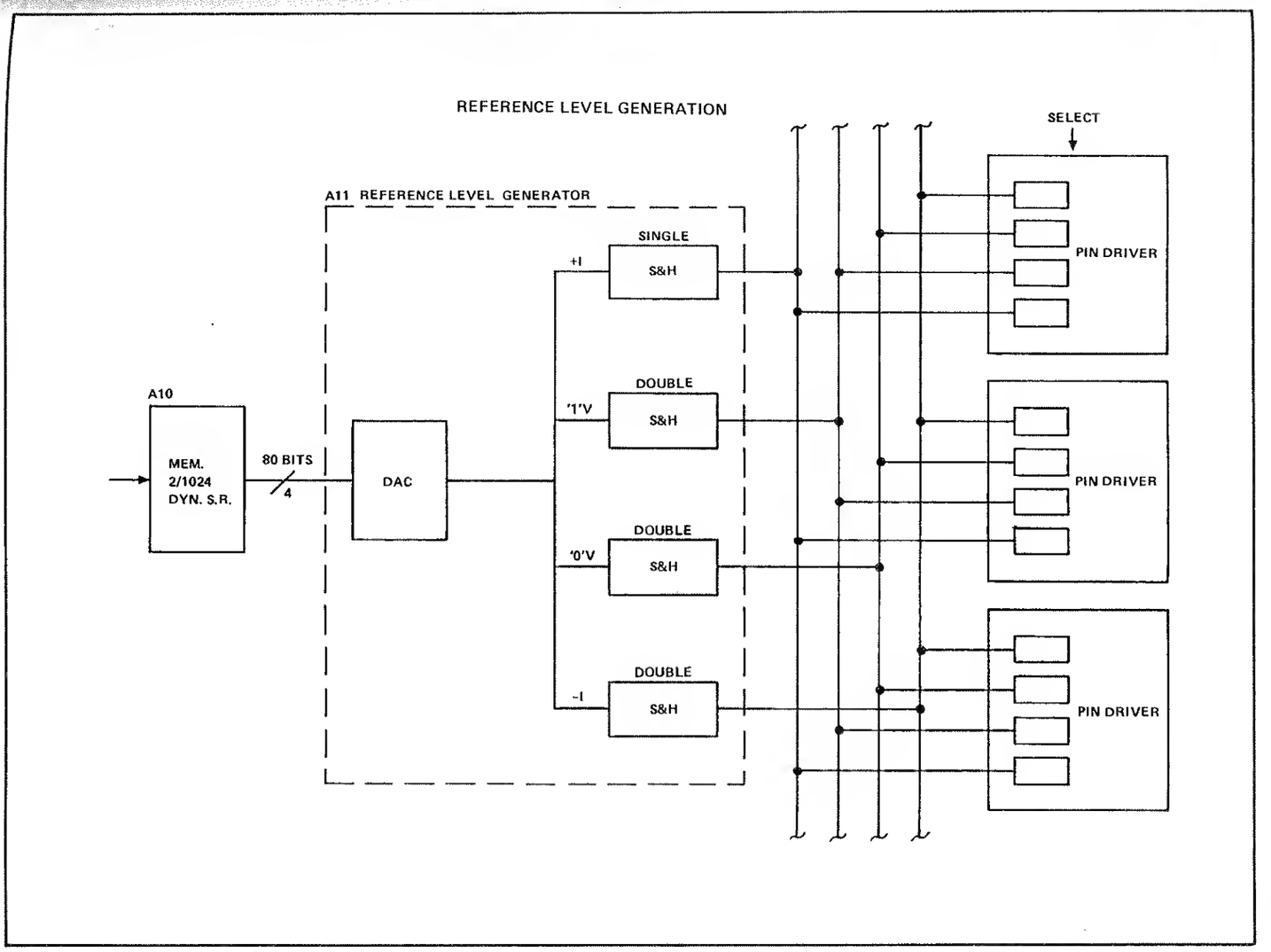


Figure 8-12. Reference Level Generation

8-179. Reference Voltages and Pin Drivers

8-180. The upper right portion of the Block Diagram depicts the Refrence Voltage Generator and Control section, along with the Pin Drivers, which drive the Device Under Test. Refer to Figure 8-12, which diagrams these sections in greater detail.

8-181. The memory shown on the left is the Reference Level Storage (RLS) Memory, located on the A10 board. This memory stores setup data that was originally stored on the magnetic program card. The data was accessed by the Card Reader, fed through the RAM, and stored in the Main Memory in the form of 24-bit words. The data is then serially transferred in 24-bit words from the Main Memory and into the RAM, where the data is reconfigured under control of the ROM program. The data is then fed into the Reference Level Storage Memory. A 12-bit *Set-up Data* word enters the Digital-to-Analog Converter (DAC) in a specific manner: the first four most-significant bits enter the DAC in parallel, followed by the remaining eight bits which, are sent in four 2-bit parallel transfers. This method of transfer allows faster settling time in the DAC than if all data were transferred serially.

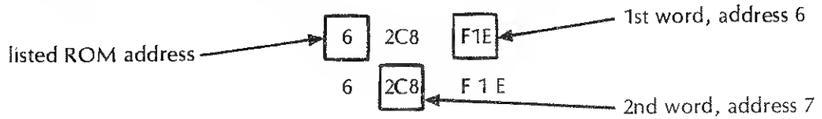
8-182. The DAC converts 11 bits of the 12-bit Setup Data word into a voltage, where upon it is clocked into a Sample and Hold (S&H) circuit (the 12th bit is used to control the range). Once done, the DAC converts the next 12-bit word into a voltage and stores that in the next S&H circuit. This process continues until all four storage circuits are filled (bottom to top), at which time the four voltages are strobed into four other S&H circuits located on the Pin Driver board. There are 12 Pin Driver boards available. Each board contains two "Pin Drivers". The first board drives pins 1 and 2 of the Device Under Test; the second board drives pins 3 and 4, etc., therefore, 12 boards for a 24-pin device.

8-183. This process of transferring data to the DAC, strobing the resultant voltages into Sample and Hold circuits, and transferring that information into the Pin Driver S&H circuits continues until all Pin Drivers contain the required information. This is a continuous operation. At the same time that each pin driver is having its reference levels strobed in, five *select* lines (also have the RLS memory) strobe that particular pin driver with information that controls certain functions on the Pin Driver boards. For example, to configure the pin driver circuits so they function as an input or an output. Refer to Figures 8-17 and 8-18.

8-184. In addition to the four reference levels and the five control lines, each pin driver must be given logic state information; i.e., is the pin driver's output going to be a logic "1" or a logic "0"? Again, this information is contained in the RAM as a 24-bit word (one bit for each pin driver). The RAM transfers this word, four bits at a time, onto another four-line bus (not the reference level bus), whereupon six strobe pulses fill all pin drivers with logic state data (6 x 4 = 24). Each pin driver circuit places its bit of data into temporary storage until all pin drivers have been set up. Then, another strobe line clocks all pin drivers to simultaneously change state.

8-185. ROM PROGRAM CONTROL THEORY

8-186. Table 8-6 lists all program words stored in the ROM. These words are listed in hexadecimal form, Table 8-7 shows the hexadecimal-to-binary conversion. The codes are grouped in a six-character format and are shown next to their respective ROM address codes. Notice, however, that the addresses are given in even numbers only. Actually, each character group contains two three-character words, with the first word being the three characters on the right-hand side and corresponding to the ROM address listed to the left. The second three-character word is on the left, and its address is the listed address plus one. For example:



8-187. Recall that all ROM information transfers onto the Program Control lines in the form of a 12-bit word. Therefore, each three-character word, shown above, translates into a 12-bit word.

8-188. There are four types of words stored in the ROM and these are shown in Table 8-8. Notice that each word is 12 bits long and that the MSB is bit 11. The three most-significant bits designate the type of word or mode of operation:

1. A RAM address code.
2. A Logic Function or Arithmetic Computation code.
c. A Data word (specifies a location, e.g., the pin driver, for the purpose of transferring data to or from the RAM).
4. A space or NOP (no operation).

8-189. In every transfer of information, the sender and receiver of data must be specified. The following paragraphs offer a closer examination of these Program Control codes and how they affect the tester's operation, followed by examples of decoding some of the words found in the ROM listing.

Table 8-6. Hexadecimal ROM Code List

```
LIST DATA

  0 C73C73   74 749321  148 004F7B  222 4E0F93  296 1F405A  370 6D4C73  444 4CCDFE
  2 C73C73   76 7F3F93  150 5F3F93  224 480D8B  298 7F6C3E  372 57DDF5  446 792DE0
  4 6C4C73   78 53BF93  152 21AC7C  226 4785FF  300 C7969B  374 39ADF5  448 2CF39A
  6 2C8F1E   80 121D9E  154 409F93  228 47A479  302 C7D6EE  376 587DF5  450 592E37
  8 4C4F93   82 321D9E  156 002D9E  230 680D8B  304 3F77F4  378 3A4DF5  452 77DF47
 10 000000   84 D9A726  158 3F8D9C  232 DBA688  306 409F93  380 191DFB  454 7F3F93
 12 000000   86 D9B122  160 7F47FB  234 DBB484  308 480DF7  382 7AEDFA  456 5C9F93
 14 000000   88 32C322  162 7F97F7  236 C1C684  310 663DE7  384 77DC67  458 1E7E37
 16 6BBC72   90 528F93  164 7FF7F5  238 C1E078  312 69B29A  386 394352  460 57DF47
 18 0BBD9B   92 557E37  166 409F93  240 DF528C  314 800800  388 1FFC9E  462 4CCF1B
 20 2BBD9B   94 480DFB  168 65FF7B  242 DF546E  316 697FBC  390 7D8C9D  464 2C0F19
 22 D9A2C3   96 65EDFA  170 415F93  244 DF5671  318 099C5B  392 2DCC7C  466 7C6E5D
 24 D9B08F   98 45EDD6  172 463F47  246 DF5464  320 7FBC5E  394 E5D6DD  468 7A9709
 26 2C62BF  100 65EDDE  174 004F7B  248 DFB667  322 1FBD9E  396 7B57CE  470 780710
 28 0C6DFE  102 484DFB  176 7F4C7D  250 DFB460  324 3F5D9B  398 4D4F93  472 7467F7
 30 DE54C6  104 662DFA  178 3F8FBD  252 D9C663  326 3F77FA  400 730E5D  474 C3E70F
 32 2C56C8  106 77EE5D  180 1F8C3D  254 D9C089  328 C7C7F4  402 7A0782  476 4CD0CC
 34 4CAF47  108 702728  182 1F91F8  256 3F4289  330 6EE6F1  404 74D74E  478 4C10C5
 36 4C4F93  110 740774  184 C3E1F8  258 48CDF5  332 004F7B  406 7C5705  480 7F3C3D
 38 2C7F1E  112 700709  186 7F73F6  260 68DDF5  334 409F93  408 C7B744  482 1ECFB7
 40 621C63  114 7247A5  188 F937F9  262 08DC17  336 462DD6  410 7BD72E  484 0C0D9E
 42 602238  116 701762  190 0005F3  264 25AC1E  338 65FDDE  412 7C0F93  486 3C8D9E
 44 4C4F93  118 702712  192 7F5FBE  266 4E0F93  340 100E0B  414 55EF93  488 F933D0
 46 7F3F93  120 777780  194 5F3F93  268 004F7B  342 05EC1D  416 35EF1A  490 0005C7
 48 431F93  122 70A760  196 409E37  270 409F93  344 C1E5E5  418 55EC1A  492 5CDF93
 50 71DE5D  124 41CF47  198 49ADFE  272 663F47  346 D9E7C5  420 7F7C1E  494 7D3C6D
 52 71871B  126 5D0F93  200 65ADFE  274 409F93  348 D9D1C5  422 161D9E  496 5C7F93
 54 7097BF  128 660C64  202 7F3F93  276 004F7B  350 3C73C9  424 7F9D9E  498 4C1C9E
 56 704780  130 680C62  204 409F93  278 478F7B  352 514DFB  426 7FC3FA  500 2DEC9E
 58 700708  132 5F4DF5  206 409F93  280 6ECC77  354 6D0DFB  428 35EC65  502 2022DD
 60 794D9A  134 2D6DE1  208 800800  282 2F02F0  356 5D4F93  430 5F3F93  504 E376CC
 62 C73794  136 7F3F93  210 0D6DF5  284 7F3F93  358 737E5D  432 7C7E5D  506 D995D0
 64 2DD6D4  138 3F3D9A  212 7F4DF4  286 409F93  360 7E0789  434 7487C3  508 7F47F3
 66 777C8E  140 603C81  214 05AD9E  288 478F7B  362 7AA761  436 D8A708  510 4D4F93
 68 7F3F93  142 213212  216 6E9D9E  290 415F93  364 D93709  438 7B13E1
 70 57CF93  144 402FB7  218 2E22E7  292 663F47  366 7C17C0  440 5D3F93
 72 72EC95  146 3F6FBE  220 409FB7  294 5F4C7E  368 57FF93  442 700F47
DATA FILES START AT 4
```

Table 8-6. Hexadecimal ROM Code List (Continued)

```
LIST DATA

  0 1F5D9D   74 6D4C73 148 52FDFE 222 6E9DF5 296 C5E789 370 7F1E5D 444 F936DC
  2 3F5D9D   76 2D9C7D 150 52D52E 224 4FBDFA 298 5AA1B2 372 F93736 446 0004D4
  4 DBB7FF   78 2DE2D7 152 52B52C 226 6F3DF2 300 5B05B2 374 0005B4 448 3B9D99
  6 5FF5F7   80 6E4E5D 154 52952A 228 3F4E5D 302 788C5E 376 110E37 450 D796F1
  8 7F7DBB   82 608620 156 527528 230 F93351 304 0D6D9E 378 2CBC7D 452 1FF4D0
 10 DBA7FF   84 620682 158 DF5526 232 0005E7 306 6D8D9B 380 7CA6CE 454 7EED6E
 12 DBA5FB   86 682608 160 DFE728 234 799C7A 308 4D4F93 382 53AF93 456 4CCF1B
 14 7F37FB   88 608620 162 524525 236 C7679F 310 401FE1 384 558DF9 458 7C0F93
 16 5F3F93   90 620682 164 732DFD 238 DFD7A5 312 110E37 386 6E0DF9 460 56EDF5
 18 6D4C73   92 682608 166 1AFD9E 240 DFE5A1 314 3C9F19 388 54EDF5 462 76FDF6
 20 3E52DD   94 608620 168 3F5D9D 242 3A93AE 316 3CD6CA 390 754DF5 464 DF575F
 22 700F47   96 F93682 170 7F97F7 244 19AC3E 318 5BFC1E 392 544DF5 466 DF5564
 24 500DDB   98 0004D4 172 3F57FA 246 5A419C 320 0CB1CC 394 74ADF5 468 DF9765
 26 5E75FF  100 718F47 174 5B0F93 248 592192 322 313C1E 396 53ADF5 470 DF955E
 28 5E95E8  102 7B6D99 176 4D4E37 250 6D6C3E 324 5C9C1C 398 740DF5 472 D7A75F
 30 DDE5EA  104 79AF47 178 6E8F47 252 7B03AF 326 3FCC1E 400 530DF5 474 5B95EE
 32 DDB718  106 10ADFD 180 777C8E 254 199D9B 328 5FBDFA 402 736DF5 476 7EED6E
 34 5FF504  108 1221A0 182 700F47 256 399D9B 330 5FC5FF 404 526DF5 478 C9A3FD
 36 5EC5EB  110 DE3523 184 0E8DF7 258 599DD7 332 3F4DF8 406 72CDF5 480 C995BA
 38 5EE5ED  112 70A394 186 720DF7 260 7AADDE 334 5C1C9E 408 51CDF5 482 3F47A6
 40 707DDE  114 72270B 188 C1D71F 262 1AAC7E 336 C9D1FC 410 722DF5 484 5B9D9D
 42 10FC18  116 E5D323 190 C1E0EC 264 5A15A2 338 E5D7F7 412 512DF5 486 7B9D9D
 44 30AC1E  118 74E7F4 192 D9E7EE 266 5201AF 340 7B972F 414 718DF5 488 D9B75E
 46 107C17  120 52FDFE 194 D9E1EE 268 C7E5A3 342 709781 416 508DF5 490 15E5BB
 48 315C1E  122 7EBDFC 196 7B13B3 270 7AF7AA 344 F9375A 418 70EDF5 492 7BBD9B
 50 1DDD9B  124 3EE7E9 198 7F3F93 272 DF57A5 346 000545 420 4FEDF5 494 C3E75E
 52 D9B5E5  126 5E7F93 200 1A8F93 274 DF5516 348 6F1FE0 422 704DF5 496 16015E
 54 3E53DD  128 525D9D 202 177D9D 276 DB9717 350 4F8C17 424 4F4DF5 498 7ECC3D
 56 1E1D9A  130 325D9D 204 377D9C 278 DBE5A5 352 710C1E 426 6FADF5 500 5EDDFA
 58 3E1D9A  132 D9B75E 206 0EFC9E 280 7A97AA 354 500C17 428 4EADF5 502 79ADE0
 60 115C1B  134 15E527 208 C9E5EE 282 5AADB9 356 711C1E 430 6F0DF5 504 59EDFE
 62 3E6C1E  136 327D9B 210 7ED3EC 284 7AADBE 358 508C17 432 4E0DF5 506 DE859E
 64 5E5C3D  138 D9B75E 212 1EDC3E 286 C5D7AE 360 712C1E 434 6EEDF5 508 7C077E
 66 5E65E5  140 55E52B 214 1EE1ED 288 1B15B0 362 510C1B 436 5AFD9B 510 5F3F93
 68 2D7C3D  142 32BD9A 216 1EE179 290 C5E5AA 364 733C1E 438 7AFD9B
 70 700F47  144 5ABD9D 218 3E9C3C 292 DF5716 366 530F93 440 DFE6DB
 72 4D4F93  146 7ABD93 220 4F1DF5 294 DF5588 368 5DDE37 442 DFE4DB
DATA FILES START AT 4
```

Table 8-6. Hexadecimal ROM Code List (Continued)

```
LIST DATA

  0 7EDD99   74 4D4F93 148 1DC5D8 222 1624FA 296 592D7B 370 7E5E5D 444 000000
  2 5BCC5C   76 6D8F18 150 7DBC1E 224 1634FB 298 1D91FF 372 7C2764 446 1E7D9B
  4 C5E5BE   78 0D8C1C 152 5D7D79 226 378C3B 300 D7B1D9 374 335C7E 448 3E7D9B
  6 C9E3F7   80 6DCC1E 154 7D7D7A 228 564DF5 302 D9C792 376 5E7F93 450 7E47FD
  8 15F5EC   82 5C1DF5 156 6D4C73 230 760DF5 304 D9C5D0 378 7D1C6B 452 7F3E5D
 10 3F4C9E   84 7F4DF4 158 2DBC7C 232 56EDF5 306 2DE7D0 380 3D53D2 454 D9E754
 12 C3D7F6   86 0DEC9E 160 7F3F93 234 76ADF5 308 5D8C1D 382 6CB3DA 456 D9C1FD
 14 C3E1F6   88 C9D4DC 162 4D4F93 236 578DFB 310 6DDC1E 384 5C4DF7 458 7F93F8
 16 3F77F5   90 DFE6DD 164 5DCD9E 238 774DE0 312 4DDC9D 386 7E7DF7 460 5F3FBB
 18 E5D383   92 4DC4DE 166 2DBD9D 240 0DBD9E 314 6D5C9E 388 7F3F93 462 5F3F93
 20 3CF3AE   94 0DD4DE 168 7F3F93 242 2D6D9D 316 DFE6DD 390 5D1F93 464 6DAE5D
 22 5ADF93   96 5CB4DC 170 4D4F93 244 DF53F7 318 4D54D5 392 69BC60 466 65F6E2
 24 5C0F93   98 6D7DFA 172 6D7FBA 246 DF54FC 320 5FF4D5 394 49BE37 468 DFD614
 26 7CFC9C 100 6D67FE 174 5D7C1D 248 DF56F8 322 DFA0DD 396 600C60 470 DFE41F
 28 5CEF93 102 4D4F93 176 4DB5DA 250 DF5506 324 F936D8 398 61FC60 472 220323
 30 57EDF9 104 3CEC71 178 6D6C1E 252 6D4702 326 0004D4 400 63EC60 474 021D98
 32 1B9151 106 7DC7DC 180 4D6DFE 254 5F3F93 328 7E1C6D 402 65DC60 476 D9A420
 34 747DFC 108 4F8DF9 182 4D60D6 256 57DDF5 330 6CCC7B 404 67CC60 478 C9A221
 36 74D74C 110 7D1DF9 184 DFB0DB 258 779DF5 332 E0B2CE 406 401FE1 480 C8F420
 38 6D674A 112 5CFF31 186 6DD6D7 260 5E7DF5 334 800100 408 5C0DFB 482 C9B600
 40 C3D746 114 510DF9 188 7DC2DE 262 783DF5 336 7D2E5D 410 7E7DF7 484 024420
 42 55154C 116 7D1DF9 190 4D4F93 264 5E1DFB 338 701709 412 E5D2B4 486 610C8F
 44 4D64D6 118 5CFF31 192 6D4F93 266 78DDFB 340 7F3F93 414 32C3F2 488 318D99
 46 750C3D 120 528DF9 194 3F3D98 268 579DF7 342 5D3F93 416 6E0C6F 490 3BF7F5
 48 C3A6D7 122 7D1DF9 196 7C0E5D 270 DF65D9 344 5F6DB8 418 2E9C7D 492 730F47
 50 5F515A 124 5CFF31 198 D9C7EF 272 DF5791 346 5E55E5 420 1F2D9E 494 518F93
 52 15E5F5 126 540DF9 200 D9C130 274 DF5599 348 7F6DBA 422 6F0D9B 496 420C9A
 54 7AFC3B 128 7D1DF9 202 2DB330 276 DF5795 350 5F3F93 424 4E0F93 498 200C8F
 56 0D6D9E 130 5CFF31 204 1F2C9E 278 DF55A3 352 5E7DFB 426 4B1FB7 500 420C9B
 58 2DBD9C 132 558DF9 206 C9E4DB 280 DFA79F 354 7C0DFB 428 6B4C6B 502 C96024
 60 2DA6DE 134 7D1DF9 208 7FB3F8 282 DF65AD 356 500DF7 430 E5D6CD 504 3BF210
 62 3F5D9A 136 5CFF31 210 1BFC3E 284 DB67A9 358 7E7DF7 432 7BE7B2 506 32321F
 64 7C0F93 138 7AFC7B 212 5FB1CC 286 DB6591 360 50CDF7 434 C65705 508 518F93
 66 4D4F93 140 1DCF3E 214 7F2C3E 288 DBA791 362 7C4DF7 436 E5D35E 510 401FE1
 68 739C7E 142 5CFD9D 216 C3E7F4 290 5D8592 364 7DDC77 438 3993F4
 70 7F9D9A 144 7CFD9D 218 1604F8 292 DBC5D8 366 7F3F93 440 1B5F1B
 72 77D3F4 146 C1D7DC 220 1614F9 294 7D9792 368 5D3F93 442 1B5F93
DATA FILES START AT 4
```

Table 8-6. Hexadecimal ROM Code List (Continued)

```
LIST DATA

  0 6E0C73   74 DFC499 148 14CE37 222 7C0F93 296 3B4C94 370 0004D4 444 719704
  2 4ECD9B   76 DF5695 150 540F93 224 5F3F93 298 5D1F93 372 1E7E37 446 7C0F93
  4 6ECD9B   78 DF549A 152 47AC18 226 6E6E5D 300 4D0DFA 374 590DFB 448 57AF93
  6 D9B6E9   80 DF5699 154 666C1E 228 6C76E4 302 394DF6 376 7E7DF7 450 7DDC77
  8 4E94F0   82 DF54A4 156 73EE5D 230 641660 304 2CC79B 378 778F47 452 583F93
 10 6F0D9B   84 DF56A3 158 DBB7C2 232 6D4605 306 7F3F93 380 6EAC7E 454 E5D600
 12 2E96EA   86 DF54AE 160 1FF54C 234 6726C4 308 401DF5 382 740E5D 456 7FB7C1
 14 4E0F93   88 DF56AD 162 DBB1FF 236 7C0F93 310 600DF5 384 704793 458 7F3F93
 16 73AE5D   90 DF54B8 164 75474C 238 51CF93 312 40FDF5 386 DFB706 460 7C1C9D
 18 760700   92 DFA6B7 166 550DBA 240 6E6E5D 314 610DF6 388 DF918C 462 58ADFB
 20 728F47   94 DF94C2 168 74CDBB 242 682600 316 DFD75F 390 DF5358 464 DFA589
 22 079E37   96 D9E6C1 170 C8B34B 244 608620 318 40040B 392 DF5582 466 7F5789
 24 0C7DFE   98 D9E067 172 6E92E0 246 60963A 320 40D55F 394 DF5786 468 746F47
 26 DFD4C7 100 6C7267 174 8006EB 248 6726E4 322 DF940E 396 DF5578 470 156C17
 28 C9E745 102 068D9B 176 7F3F93 250 7C0F93 324 C5D60A 398 D9B77C 472 3F7C1E
 30 145066 104 D9B0C7 178 4E0F93 252 51CF93 326 55E15E 400 D80594 474 59AF93
 32 743C9D 106 6C7268 180 201C67 254 6E6E5D 328 C5E00C 402 C1B794 476 58EF93
 34 31BC7D 108 528D9E 182 7FAFE0 256 652600 330 D9A2E6 404 4EA558 478 5A3E37
 36 F9331F 110 728D9E 184 319C7D 258 621643 332 D9B2E7 406 C1E198 480 746F47
 38 000540 112 D9B74C 186 7FF31D 260 6CF649 334 D9B194 408 C9B75C 482 156C17
 40 745C79 114 14C529 188 540F93 262 6726C0 336 6EA394 410 C99594 484 2DAC1E
 42 543E37 116 729D9B 190 130E37 264 1CCD9E 338 599D9B 412 C7C7F0 486 589DFA
 44 481F47 118 DFE347 192 540F93 266 7C0D97 340 799D9B 414 DFE2D8 488 78ADFB
 46 143E37 120 147147 194 696E5D 268 75E3C8 342 C7B2DA 416 5981F5 490 DFE789
 48 6B0F47 122 743DFB 196 6356BE 270 51CF93 344 D9E7AF 418 5981FF 492 DFD0DA
 50 079D9B 124 F93349 198 6F36F9 272 6E6F47 346 D9C0DA 420 DFA198 494 D9E7F4
 52 279D9B 126 000540 200 600605 274 7CDC7E 348 69E2DB 422 3F47F6 496 D9D19D
 54 D9B2C7 128 538D7B 202 4C0E37 276 3F4D99 350 5CCC9E 424 39E3A3 498 C1D2DB
 56 0C707D 130 4791FF 204 4A4F47 278 5CDD9E 352 C9D0DA 426 7BA3A0 500 4CA4DA
 58 27DD9B 132 47B47A 206 3FBC7E 280 3F5D9E 354 C3E6D7 428 4D4F93 502 2D7C1E
 60 267C7E 134 D7B47C 208 498F93 282 7FB7F7 356 0E60EA 430 30AE5D 504 0D7D9E
 62 34A26A 136 74074C 210 724E5D 284 7FE7FD 358 C3E4D7 432 3FA3CB 506 6D9D9D
 64 482DF5 138 53CD7A 212 74E7EA 286 1E7DFB 360 6D62E6 434 5DDE37 508 6DE2DD
 66 681DF5 140 47E47D 214 781702 288 390DF7 362 7F57F4 436 71CC79 510 4D4F93
 68 48CDF5 142 48047F 216 71274C 290 7CFE5D 364 194DBB 438 747320
 70 68BDF5 144 750D7A 218 E5D718 292 722712 366 DBB0EA 440 778E5D
 72 496DFD 146 34B740 220 7137F3 294 7FF7F0 368 F93394 442 72474C
DATA FILES START AT 4
```

Table 8-6. Hexadecimal ROM Code List (Continued)

```
LIST DATA

  0 51EFD7   74 4E9DFD 148 7D1DF5 222 7F3F93 296 787DF1 370 58DDF8 444 701786
  2 77DFBB   76 4E95FF 150 50BDF7 224 4D4F93 298 119DF8 372 DF70E6 446 7F3F93
  4 57BC9E   78 4E74E8 152 7DFDF7 226 6FDE5D 300 3F4DF7 374 800791 448 5D0F93
  6 C9E180   80 7A3DF0 154 5A9DF9 228 6A1686 302 4D4F93 376 7A1E5D 450 57DDF9
  8 77E37D   82 5C9DF5 156 7C9DF8 230 C5E691 304 79DE5D 378 7F4794 452 752DFB
 10 57EDFE   84 719DF5 158 5EDDFA 232 582598 306 771734 380 7F3F93 454 759758
 12 77FDFE   86 5D3DF8 160 321DFA 234 581195 308 5FFDFE 382 5A1F93 456 C1B356
 14 57CF93   88 723DF8 162 77BC93 236 70FC5E 310 1EC5FF 384 38DC9B 458 C1E558
 16 6E0FD9   90 7F3F93 164 31F387 238 188C9E 312 7580FC 386 32672D 460 D9975C
 18 52EFD2   92 4FFF93 166 7F3F93 240 50F4F1 314 5A0F93 388 55FC9E 462 6ED6EC
 20 594FDA   94 4EADFE 168 57CF93 242 7C0C9D 316 587DFB 390 C9D0CC 464 7252E6
 22 53AFCC   96 4E74E8 170 722C93 244 0F1C9E 318 DFB5EC 392 E5D799 466 5B8DF8
 24 546FCC   98 7A3DFC 172 6D6E5D 246 C9C50F 320 78A7DB 394 3BD3F4 468 7F4DF7
 26 552FD2  100 7F3F93 174 C3E638 248 30E7C2 322 388C9D 396 79CF93 470 3873FC
 28 4D4F93  102 4FFF93 176 596589 250 50FC3E 324 79DE5D 398 4D4F93 472 F932CB
 30 72EFD9  104 57DDF5 178 C3E196 252 50F588 326 78C749 400 1D1DF5 474 0004D4
 32 72EFD2  106 6E7DF5 180 7D0796 254 C3E588 328 59EF93 402 37DDEF 476 346C67
 34 794FDA  108 587DF6 182 196C7E 256 71030F 330 521DF6 404 3262EB 478 73FFE0
 36 73AFCC  110 6F1DF6 184 C7E58A 258 7C3C7A 332 39ADF6 406 DFD800 480 3F4E5D
 38 746FCC  112 77DC67 186 C9D78A 260 188C5E 334 5DADFC 408 1EB5DB 482 800388
 40 752FD2  114 5C0D9B 188 C9C188 262 10E4F1 336 3A3DFC 410 DFD59A 484 1E1DFA
 42 4D4F93  116 7C0D9B 190 C9C784 264 C5E10E 338 5DDDF5 412 798787 486 33FDF9
 44 4E7DF5  118 D9A7C8 192 C98588 266 C677C4 340 3A6DF3 414 789799 488 540D9B
 46 2E7DF5  120 D9B5C4 194 C5E77D 268 C6C77D 342 6E4E5D 416 5DDDF5 490 D9B53F
 48 39AC7E  122 C177C4 196 57F597 270 E5D79A 344 601684 418 78DDF4 492 6DF740
 50 39F39C  124 C1E5C0 198 583583 272 70B7F3 346 7F3F93 420 7ADC9D 494 546DFA
 52 0F0D9E  126 D9E7F4 200 782C5E 274 5F6DBB 348 4E6F93 422 E5D715 496 4DF53F
 54 77DD9E  128 D991F4 202 194C5E 276 DBB4E6 350 587DFB 424 3BD3F4 498 745DFA
 56 78277F  130 3F57F6 204 58157D 278 F937F6 352 5EC5B2 426 79CF93 500 6D733F
 58 0EFD9E  132 7F73F6 206 C5E581 280 0005F3 354 7DBDFB 428 4D4F93 502 548DF5
 60 781D9E  134 4E7DF5 208 C3D781 282 581DF5 356 7897EB 430 5B3DFA 504 74ADF5
 62 DFE783  136 79ADF5 210 581581 284 77DDF5 358 78A388 432 77DDE7 506 555DF6
 64 4ED4EE  138 4F1DF6 212 C3D586 286 58BDF5 360 79DE5D 434 5B7DFE 508 DF5545
 66 4EB4EC  140 7A4DF1 214 3AF7B0 288 787DF1 362 7D4749 436 DE85B7 510 D9E754
 68 4E94EA  142 4FFF93 216 5B0C1D 290 581DF5 364 59EF93 438 39A79B
 70 4E74E8  144 50BF93 218 C1E584 292 77DDF5 366 521DF6 440 723D9A
 72 785DF7  146 57DDF5 220 8003B2 294 58BDF5 368 7D1DF6 442 7CEE5D
DATA FILES START AT 4
```

Table 8-6. Hexadecimal ROM Code List (Continued)

```
LIST DATA

  0 D990DF   74 4D4F93 148 415DFB 222 C7C726 296 720321 370 C9D312 444 E5D2EC
  2 F936D9   76 586C1A 150 5B35ED 224 7BA3BC 298 3F03F4 372 75272F 446 77E7F3
  4 0004D4   78 5AC5AB 152 DFB5ED 226 5F3F93 300 3D1778 374 5B3C7C 448 4D4F93
  6 198C9D   80 C1E1AD 154 3ED75A 228 55FD9E 302 5BADFC 376 1A25A1 450 145C9E
  8 C9D0CB   82 DFD7F7 156 7F23B3 230 6F4D9D 304 7B0DFC 378 3ADC7D 452 C9C1CL
 10 C9D77D   84 1515F6 158 D9B3F8 232 75F2F7 306 57CF93 380 CDB2CB 454 C5E3CA
 12 C9D598   86 59C151 160 1B35B4 234 178D9E 308 5CDF93 382 C3E1AD 456 1CB1CD
 14 72637F   88 7F4DFC 162 7B4D9B 236 72AD9D 310 7D1C7E 384 7A27C0 458 4CC4CC
 16 598DFE   90 7AF7F9 164 D772CC 238 E5D32D 312 5CEF93 386 3B97A4 460 7C1C5E
 18 19857F   92 7B27B1 166 4CC5EE 240 3423C0 314 5BAC5C 388 7F3F93 462 5CFC3E
 20 77DDFE   94 2DC2DB 168 7EED7B 242 3EE3C5 316 C5E116 390 5CEF93 464 1451A0
 22 3AD780   96 4D4F93 170 57CF93 244 6D8F13 318 C7E7A1 392 7B1C7E 466 3A0C3E
 24 3AE798   98 19DDF5 172 562DF5 246 F936CC 320 5EC57A 394 5DAF93 468 C957CD
 26 57DDFB 100 3F4DF5 174 746DF5 248 0005CC 322 3A2C7C 396 7AFC9B 470 37D77B
 28 722DFB 102 4D4F93 176 56CDF5 250 720D99 324 7B27A3 398 51CC7E 472 1EAFD7
 30 581DF5 104 3ECD8C 178 750DF5 252 77BC93 326 7F3F93 400 5AE1A2 474 7F3F93
 32 77DDF5 106 5DDE37 180 576DFD 254 7F3F93 328 5DAF93 402 1A21A2 476 57CF93
 34 58BDF5 108 590DFB 182 561560 256 57CF93 330 1BAC9E 404 3C1C7E 478 5CEF93
 36 787DF5 110 7E7DFB 184 DFB545 258 7CCE5D 332 3F6C9C 406 7B13A0 480 000000
 38 595DFC 112 4D0DFB 186 7EC75A 260 7A3780 334 8003A0 408 7F3F93 482 5DAF93
 40 791DF8 114 7B4DFB 188 75F3F7 262 C5E72E 336 19FC7B 410 5CEF93 484 000000
 42 123C9D 116 8007B3 190 57CF93 264 5780CC 338 C7C521 412 79EC7E 486 521C7E
 44 522525 118 7F4E5D 192 0CCC5E 266 7F9C5E 340 E5D7AF 414 5CEF93 488 5A31BC
 46 7A8C9A 120 DDA750 194 C52545 268 3F3D99 342 77D6E4 416 5C0C9D 490 5A4598
 48 1ABC5D 122 5B34D0 196 37B778 270 C7E39E 344 756719 418 C9E5A0 492 C7E595
 50 126126 124 5B55B4 198 720D99 272 5CD55F 346 712743 420 3B26CC 494 798721
 52 19C19C 126 DDE5B6 200 80037D 274 77AC72 348 E5D700 422 588DFE 496 3BC795
 54 39CC5E 128 F933F5 202 1EAFD7 276 C5E3AF 350 77D72C 424 3A3DF0 498 1B9D89
 56 58CC18 130 0004D4 204 7F3F93 278 55F196 352 756711 426 7F3F93 500 DBB1FF
 58 C1E59C 132 0D0DF6 206 57CF93 280 7B8C58 354 713783 428 5DAF93 502 C797AF
 60 C5C79C 134 3EDDF5 208 77BC79 282 1FDC7C 356 C5C7BE 430 5B9DFB 504 D9E7B9
 62 1265AC 136 77CE5D 210 57CF93 284 5EC55F 358 5981B9 432 5A05B2 506 D9A5C1
 64 326C5E 138 702779 212 800800 286 C7A5B8 360 1955BB 434 7AFDFB 508 7F83F7
 66 57DC17 140 401DF5 214 800800 288 DFA3B9 362 7B2C5E 436 2DE7BC 510 5CEF93
 68 7ABC1E 142 746DF5 216 178D9E 290 1965ED 364 4D4F93 438 5BBC9D
 70 2DBC7D 144 40BDF5 218 3B8D9B 292 5F94CC 366 332E5D 440 C9D121
 72 7F3F93 146 750DF5 220 7F4E5D 294 DFA55F 368 3453B1 442 C777A3
DATA FILES START AT 4
```

Table 8-7. Hexadecimal-to-Binary Conversion

Character	8	4	2	1
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
A	1	0	1	0
B	1	0	1	1
C	1	1	0	0
D	1	1	0	1
E	1	1	1	0
F	1	1	1	1

Table 8-8. Processor Instruction Decoder

<table>
<tr><th>Bit Number</th><th>RAM Address</th><th>Logic Function/ Arith Computation</th><th>Data Entry/Exit</th><th>No Op</th><th>Not Used</th></tr>
<tr><td>0
1
2
3
4
5
6
7
8</td><td>RAM Address</td><td colspan="2">Number of Bits in Word
(Take Complement)
Op Code / Data Location Code</td><td>0
0
0
0
0
0
0
0
0</td><td>Not Used</td></tr>
<tr><td>9</td><td>Read/Write (0) (1)</td><td>0</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>10</td><td>True/Comp (1) (0)</td><td>1</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>11</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
</table>

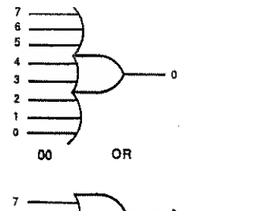
8-190. Logic Function/Arithmetic Computation

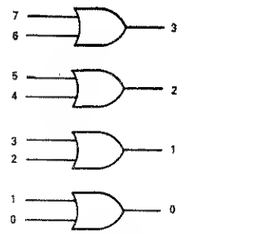
8-191. As previously mentioned, the second column in Table 8-8 contains codes that represent either a Logic Function or Arithmetic Computation, i.e., a function of the ALU. Again, the first three bits (110) are responsible for selecting this column, or, rather, the mode itself. The result is that whatever serial data is subsequently exchanged will be with respect to the ALU.

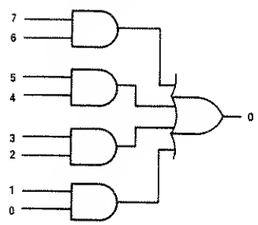
8-192. The second four bits designate the op code (operation code), i.e., the specific operation to be performed. These four bits represent an octal code that corresponds to one of those found in Figure 8-13. For example, the octal number representing the AN OR Logic Function is 02. Bits 5 through 8 would contain the binary equivalent of this octal number:

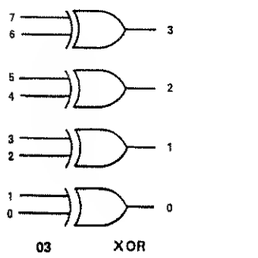
0 2

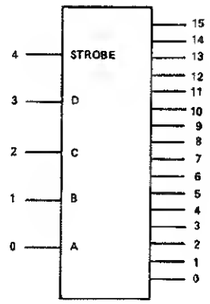
0 010

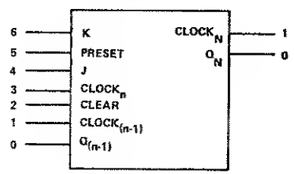


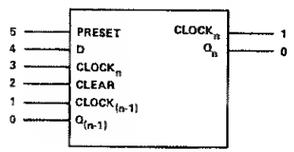


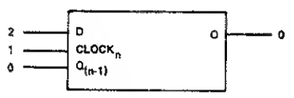


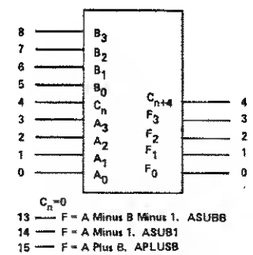












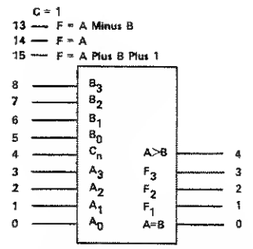


Figure 8-13. Op Code Guide

8-193. The last five bits (Bits 0-4) of the 12-bit word specifies the number of bits involved in the *forthcoming* data transfer. If the purpose of this transfer were to place a stimulus on the AND OR logic model, up to eight bits of information would be needed (one for each input of the model). Those inputs not specified are set to "0". To place a "1" on each input would require a binary eight; however, the binary code used in this portion of the word is always the complement of the desired number. (The tester keeps track of the number of bits transferred by storing this code into a 5-bit counter. As each bit is transferred, the counter is clocked until it overflows.) Since the 5-bit code is weighted in-binary $\left(\begin{matrix}\text{bit} - 4\ 3\ 2\ 1\ 0 \\ \text{weight} - 16\ 8\ 4\ 2\ 1\end{matrix}\right)$, an eight would appear as $\left(\frac{43210}{10111}\right)$, which is actually the complement of eight $\left(\frac{43210}{01000}\right)$. When examining this portion of the 12-bit word, it is easier to refer to the zeros than to perform the complement exercise.

8-194. Now that the ALU function has been selected and the number of bits involved in the transfer has been specified, another Program Control word is needed to regulate the process of transferring serial data. This word-type is found in column 1 of Table 8-8 and is called, simply, the RAM Address code.

8-195. RAM Address

8-196. The MSB of the code is a "0" and is responsible for designating this word as a RAM address. The second MSB (bit number 10) determines whether or not the *serial data* transferring either to or from the RAM is to be complemented (inverted in state). Bit number nine specifies the *direction* of the transferring data: 0 = "read from the RAM", 1= "write into the RAM". The $\left(\begin{matrix}8 & 7 & 6 & 5 & 4 & 3 & 2 & 1 & 0 & \text{- Bit} \\ 256 & 128 & 64 & 32 & 16 & 8 & 4 & 2 & 1 & \text{- Weight}\end{matrix}\right)$. The RAM Address Register stores these last nine bits and uses them to address a RAM data location.

8-197. To complete the above example, assume data is being read from the RAM and to the ALU; therefore, the RAM must already contain the information to be sent. (The result of a previous data transfer.) Also, the RAM has been addressed to its starting location by the RAM address code, which was stored in the RAM Address Register. Each time a bit of data is clocked from the RAM, the RAM Address Register advances one location and the "bit counter" increments by one count. This continues until all data bits are transferred from the RAM, at which time the bit counter overflows and ends the transfer process. The Processor Memory sends out a *program advance* signal and then examines the next Program Control code. This could be another ALU function, for example, or another RAM Address code or a series of these codes that would address individual RAM locations for the purpose of transferring single bits of data.

8-198. Data Entry/Exit

8-199. The next column to be examined is DATA ENTRY/EXIT. This type of word is used when sections of the tester, other than the ALU, require the transfer of serial data to or from the RAM. The code's first three bits (111) specify it as being a DATA ENTRY/EXIT word. The next four bits (Bit numbers 5 through 8) designate the *other* section of the tester involved in the forthcoming data transfer (the RAM is always one of the two). Table 8-9 shows the octal characters that are found in this portion of the Program Control Word and the corresponding section it represents.

8-200. The last five bits of the word specify the number of serial bits to be transferred. Again, this number is expressed as the complement of the number. Once the Processor Memory has accepted this code (in the same manner as the Logic Function example), a RAM address code is needed to determine the direction of data flow and the starting RAM address.

Table 8-9. Data Entry/Exit Codes

Code	Data Location
00	Relay
01	Main Memory Advance
02	Data read from eight least significant bits of the Program Control lines
03	I/O Board
10_8	Front Panel* (each bit is transferred in order)
11_8	Printer
12_8	Magnetic Card Reader
13_8	Main Memory
14_8	ROM Address Counter
15_8	External Control**
16_8	Digital-to-Analog Converter
17_8	Pin Driver Board (bit pattern, failure data)

*Data to Front Panel:
(1) Fail Lamp
(2) Cont. Lamp
(3) Pass/Fail (Sort/Access)

Data from Front Panel:
(1) Load
(2) Write
(3) Terminate Test
(4) Continue on Fail
(5) End on Failure
(6) Test
(7) Printer
(8) I & V

**External Control from the CPU (from the RAM)

2^0 Record 1 = Read, 0 – Write

2^1 Load light

2^2 SRQ – I/O Board

2^3 Pin Driver on

2^4 End of Test

2^5 (Not Used)

2^6 (Not Used)

2^7 Sort (reject)

External Control to the CPU (to the RAM)

2^0 Card in

2^1 MFL (sync)

2^2 End of Card Record

2^3 Ready (D/A)

2^4 Request (printer)

8-201. In this example, as with the Logic Function example, the RAM address word always *follows* the Logic Function/Arithmetic Computation and Data Entry/Exit words. This is not true of the Special code, found in column 4 of Table 8-8. This code is a no op (no operation) code and performs no actual function. It does not address the RAM Address Register, but it does generate a Program Advance signal to advance the ROM program.

8-202. DECODING THE ROM WORDS

8-203. Now that the ROM words have been examined as to their type and function, the following paragraphs will describe the process of decoding the hexadecimal words into 12-bit Program Control words. ROM addresses 6 and 7 will serve as an example for this decoding. Table 8-6 lists these addresses as "6 2C8FIE".

8-204. The decoding process begins by first examining ROM address 6, which contains the word FIE. Referring to Table 8-7, Hexadecimal-to-Binary Conversion, the codes appear as shown below.

	F	1	E	
(MSB)	1111	0001	1110	(LSB)

8-205. Once the word is converted to this form, Table 8-8 can be used in determining the type of word it is. Notice that the three-most significant bits are all 1's. Locating this in Table 8-8 reveals the word to be a DATA ENTRY/EXIT word.

8-206. The next step is to separate the coded word into sections, as its particular word type demands. In this case

111	1000	11110.
Specifies DATA ENTRY EXIT	Specifies Data Location (10_8)	Specifies Number of Bits in word in complement form

8-207. The Middle portion of the word is expressed in octal with the first three bits on the right being the LSD. Therefore, this code translates to octal 10. Table 8-9 reveals this Data Location to be the front panel.

8-208. The last step in decoding this word is to examine the last five bits (11110). Table 8-8 points out that this specifies the number of bits in the data word to be transferred and that this information is given in complement form. Taking the complement reveals that only one data bit will be transferred:

	16	8	4	2	1
11110	0	0	0	0	1

8-209. Again, an easier method is to consider the zeros to be true. The second part of the transmission information (RAM Address 7) can now be translated. The word in this location is 2C8. This translates as shown.

2	C	8		
(MSB)	0010	1100	1000	(LSB)

8-210. A zero in the MSB designates this word as a RAM address code. It can then be sectioned into the particular word-type format, as outlined in Table 8-3.

0	0	1	011001000

8-211. The '0' located in bit 10 specifies that the data bit to be transferred will be inverted in state. The '1' located in bit 9 means the data bit will be written into the RAM. The last step is to decode the RAM address information. The data bit will be written into this location. This conversion appears as follows:

256	128	64	32	16	8	4	2	1	--- weight
0	1	1	0	0	1	0	0	0	--- bit

Therefore, 128 + 64 +8 = RAM Address 2ØØ.

8-212. The two words have been combined to give all information necessary for governing the transfer of data. The codes have decreed that one data bit from th front panel is to be written into RAM location 2ØØ. Knowing this, Table 8-9 can be referred to, once again, to determine the purpose of the data bit. Noting the asterisk that references "Data *from* the Front Panel," the transfer of a single bit of data from the front panel means that the bit will be *load* information. Specifically, "was the LOAD button pushed?" To determine the position of the PRINTER switch, for example, requires transferring seven bits of data; only the seventh bit is of importance. The RAM will store the previous six bits but may later write over that information.

8-213. The tester's ROM sequence and operation is outlined in paragraph 8-149. ROM Mnemonic Code List. Refer to the decimal side of the ROM Address column. The ROM Address 6 line outlines the previous example: front panel data, TO the RAM, take the complement (c) of the transferring data, and place it in RAM location 2ØØ (first or starting address is 2ØØ, ending address is 2ØØ).

8-214. A4 ARITHMETIC/LOGIC UNIT OVERVIEW

8-215. The main purpose of the Arithmetic/Logic Unit board (A4) is to simulate a logic model, as described in the Block Diagram Theory. The simulators, themselves, are actually groups of blocks on the board that may be combined to form a particular function (refer to A4 schematic). The simulators are the ALU (U8) and those groups designated on the schematic: the JK simulator, the 4-16 Line Decoder simulator, etc. The operation involves using a portion of the 12 bit Program Control word (the Op code) to specify the function to be performed (OR, D type F-F, A=8, etc. See Figure 8-13. Once this is determined, serial data is received from the RAM and converted to a parallel format so it can be presented to the inputs of the Model. The results of this operation are then transferred serially back to the RAM (A5) on command.

8-216. The OP CODE-DATA LOC lines entering U22 are also sent to U23. If the lines contain a Data Location code, this code enables one of U23's outputs, provided G_1 and G_2 are Low. This output enables one of the blocks inside the tester (printer, front panel, etc.) to receive data from the RAM. This particular function is unrelated to the other operations on the ALU board and can be thought of as part of the Processor Memory, A5.

8-217. If the OP CODE-DATA LOC lines entering U22 contain an Op code, then U22 and the encoder gates (U16D, U14A, B, and C, and U13E) present a Select code to the ALU, U8. Once U8 has been coded to perform a function, the data can be placed across the A and 8 inputs of U8.

8-218. The ALU board accepts the input data on pin 7, the RAM MEM OUT line. The data input control circuit (U11C, U17A, B and U2) controls the loading of data into the Logic Simulation Set-up Storage circuit (U3 and U4). This circuit is cleared to '0' prior to use so that only the '1' state data bits change the storage data. The data is not loaded directly into U3 and U4 but, rather, controls whether the devices are preset to accept logic levels from U2. To begin with, U2 is preset such that a '1' is placed on the O_A output. Since U17A *alternately* selects either U10B or U10C to pass the data latched in U11C, then U3(I_E) will preset to the same level as the data input. On the next clock pulse, a new bit of '1' state data may be preset into U4(E) in the same manner. (It should be noted that the clock input of U3 and U4 are disabled throughout this process.) After the second clock pulse, the '1' in U2 has shifted to the O_D output, which enables the D inputs of U3 and U4 to be preset by incoming data. This process continues until all data is loaded (up to 10 bits) into U3 and U4. The data goes to the different simulators on the board.

8-219. The results of the simulation is fed to the D inputs of U15. When the DATA XFER/$\overline{\text{LOGIC FUNC}}$ line is Low, it enables the STROBE input, which activates the IC. This IC then uses the Op code to select one of the inputs to pass simulator data to U7 where it is shifted back to the RAM on A5.

8-220. A5 PROCESSOR MEMORY OVERVIEW

8-221. The Processor Memory board contains the 512-bit RAM and its associated Address Register and Word Counter (refer to A5 schematic). Also located on this board are the Constant Converter, the Input Data Selector, and a storage element for the Op Code or Data Location. These blocks operate in accordance with the type of Program Control word placed on Program Control lines, PROG BITS 0-11. The following is a brief statement on each of the schematic blocks.

8-222. **512-Bit RAM.** The RAM consists of two Read/Write Memories, U10 and U11. Only one of these memories is addressed at a time. U10 contains locations from 0-255 while U11 covers locations 256-511. Before these memories can be used, PROG BIT 11 must be a "0". This bit is stored in U6A. PROG BIT 8 selects either U10 or U11 for operation, and PROG BIT 9 (through U12) selects the Read or Write mode. Bit 10, stored in U12D(6,12), determines if data into or out of the RAM is to be true or complement.

8-223. **RAM Address Register.** This register is responsible for addressing the ROM and is formed by U15, U18, and the first bit of U12. The second bit of U12 is an overflow. A new address is loaded into the register when the Q output of U6B is low. Once loaded, the register's address can be incremented by clock pulses. Clocking is controlled by U13A and U13C.

8-224. **Word Counter.** The Word Counter consists of U16 and the first bit of U9. Loading is enabled by U13B. The number stored in this counter is the complement of the number of bits in the word to be transferred. Counter overflows when all bits have been transferred.

8-225. **Register/Word Counter Load Control.** Depending on the state of the Word Counter, U6B will enable the RAM Address Register to load another address or it will enable U13B to load the Word Counter when the appropriate Program Control word demands this operation.

8-226. **Program Advance Counter.** Under all conditions except a Special code, U1 is loading a binary 15(1111). Whether or not the device outputs a carry to the Program Advance line depends on the output of U2A. With a Constant Code, the device loads a binary 9(1001) one clock pulse after it loads a 15.

8-227. **Op Code or Data Location Storage.** When U13B's output is low, U19 stores either the Op Code or Data Location Code, available on PROG BITS 5-8. This information is fed to A4, as well as being used on A5.

8-228. **RAM Input Data Selector.** The data on the A, B, and C input lines can be an Op Code or a Data Location Code. If it is a Data Location code, U13C enables U20 to pass data from the selected data source, through U3A, U4B, and into the RAM. If data is transferred fro the RAM, Program Bits 5 through 8 are used by A4U23 to select the recipient of the data.

8-229. **Constant Converter.** The Constant Converter, U14, is used when the tester reads the eight least-significant bits from the Program Control lines into RAM storage. This process requires a parallel-to-serial conversion, which U14 provides. Once the 8-bit word is loaded into U14, it is clocked out serially and into the RAM via U7C, U3A, and U4B.

8-230. EXAMPLE OF OPERATION

8-231. The following example will outline the Processor Memory's operation with a Data Entry/Exit Code and then a RAM Address code. Refer for a moment to Table 8-8 and note the format

of the Data Entry/Exit word. The first two bits and the High $\overline{Q}$ output of U6B allow U13B to store the 4-bit Data Location code into U19. The Low output of U13B also loads PROG BITS 0-4 into the Word Counter, U16 and U9. At this time, the Q outputs of U6A and U6B are High and disable the RAM and the LOAD line of the RAM Address Register. The low $\overline{Q}$ output of the Bit 11 Latch, U6A, disables U13C until the RAM Address Code is presented. When the Data Entry/Exit word is accepted, U13B enables U2A, which allows U1 to output a PROGRAM ADVANCE signal. This is a signal for the program source to present the next Program Control word.

8-232. Once the RAM Address code appears on the Program Control lines, the address (PROG BITS 0-8) is loaded into the RAM Address Register. This is done with the Low Q output of U6B. The same clock pulse that initiates this action also clocks the "0" of PROG BIT 11 onto the Q output of U6A, thus enabling the RAM. If PROG BIT 9 is a "1", it allows data to be written into the RAM by enabling U13A. In this mode, U13C causes U20 to select a data source and transfer the data through U20A, U3A, and the Exclusive OR, U4B. If bit 9 were a "0", the mode would be "read from the RAM". Data would then pass through U2D, U5D, and U5E and out on the RAM MEM OUT line.

8-233. Transferring bits of data, either to or from the RAM, occurs with each clock pulse. These pulses advance both the RAM Address Register and the Word Counter. When in the Write mode, these clock pulses also generate a Read/Write operation on the RAM. After all data bits are transferred, the Word Counter is at a binary 15. This enables U2A, thereby allowing U1 to output a Program Advance.

8-234. A6 MAIN MEMORY OVERVIEW

8-235. The Main Memory circuitry is represented on the schematic diagram Figure 8-11. As mentioned in the Block Diagram theory, the Main Memory stores all informatio taken from the magnetic program card. Data enters the memory serially and can be removed serially or in parallel. If removed in parallel, it is in the form of a 12-bit Program Control word and is sent to the Processor Memory board — A5. If removed serially, it is also sent to A5, but it will enter the RAM. During a Logic Model simulation, this memory, not the ROM, has full program control of the tester.

8-236. The actual memory is shown on Sheet 2 of the two schematics representing A6. The top three IC's (U34, 33, and 32) are data switches. Depending on the state of the select line, these IC's transfer a 12-bit word from either the ROM or the Main Memory onto the Program Control lines.

8-237. The middle row of IC's (U36, 26, 19, etc.) are 4-bit Shift Registers that can be loaded with data in two ways: (1) enabled and clocked in a serial mode or (2) enabled and clocked in a parallel mode. These registers never function as anything more than a temporary storage location.

8-238. The bottom row of IC's (U35, 25, 18, etc.) comprise the actual memory. Each IC contains four rows of data with each row being 256 bits long. Data is serially shifted in each row with two clock signals. These clocks are generated on A6 and are shown on Sheet 1. They are basically the same signal but 180° out of phase with one another, hence Ø1 and Ø2. Each clock phase clocks in data.

8-239. A characteristic of the Main Memory is that it is a *dynamic* shift register. This means that once data is stored, the contents of the memory must somehow be changed within a period of time; otherwise, the energy level holding that data bit in memory will decay, and the data will be lost. The memory is changed when Ø1 or Ø2 clock signals occur; however, these signals are not always present. They occur only when the memory is accessed or if new data has not entered within a set period of time (about 0.5 msec). If approximately 0.5 msec elapses with no access of data, the memory goes into a *refresh* mode, which means that the memory shifts itself 256 pieces. This refreshes the memory's energy level and replaces the data to its position prior to the refresh mode.

8-240. Loading Data into the Memory

8-241. Loading into the memory is done with the help of a circuit (U31 and U22F) shown on the upper right corner of Sheet 1. Recall that when serial data enters the memory, it is in the form of two 12-bit words. This data comes from the RAM and enters A6 on pin 7. The two AND gates of U31 are alternately clocked to pass data from both the RAM MEM OUT line and the Q_C output of U17 (Sheet 2). These alternate bits of data enter pin 1 of U36 and are shifted through the middle row of shift registers at twice the rate as data input on the board. After the first 12 bits of data are entered, they appear on the Q_A and Q_C outputs of each IC, with the Q_B and Q_D outputs holding whatever was being shifted out of U17(11).

8-242. The next 12 bits, the second word, is now entered in the same manner: one bit of RAM data then one bit of data from U17(11). This time, however, data from U17(11) will be the first 12-bit data word previously entered. After the second 12 bits are entered, the loading operation is complete. The first word appears on the Q_A and Q_C outputs and the second words appears on the Q_B and Q_D outputs. (Note the connections to the switching IC's.)

8-243. The outputs of the 4-bit shift registers connect to the inputs of the memory shift registers. This data is now loaded into memory with each phase of the two-phase clock.

8-244. When memory data is to be passed onto the Program Control lines, the data to be transferred (both 12-bit words) appears on the memory's output lines. It is then parallel loaded into the middle row of shift registers. The 12-bit word on the Q_B and Q_D outputs pass through the switches and onto the Program Control lines. Then a *shift-right* operation is performed on the register and the second 12-bit word is read out.

8-245. The circuitry represented on Sheet 1 controls the Main Memory's operation. For example, U1 and U2 are presettable binary counters and are used to regulate the 256-bit cycle when the Main Memory is in the refresh mode. Although the counter does not keep track of memory locations during normal data transfer, it can be used to advance the program by N bits. This information is inserted into the D_D input of U1 in a serial manner (8 parallel load operation) and is the complement of the number of bits to be advanced.

8-246. When the memory outputs its Setup Data, it is a continuous process and the refresh mode is not needed. Should the memory stop outputting, e.g., if a failure is detected in the Hold on Fail/Step mode, then the refresh mode is necessary.

8-247. Assume that the memory has stopped outputting data but the Refresh One-Shot, U12, has not yet timed out. At this point, the outputs of the Main Memory Advance Counter, U1 and U2, are sitting at all one's, including the Carry Output.

8-248. The next clock pulse does not clock the counter, because the High on U3B(5) causes U11B to disable the counter. However, because the Refresh One-Shot has not yet timed out, U29A(2) will be High, and this clock pulse will cause U29A to set. This places a High on U11B(5), which keeps the counter disabled through subsequent clock pulses, until the one-shot times out. When this occurs, U29A switches state on the next clock pulse and allows the countr to function, once again. The first clock pulse into the counter sets the carry output Low, which results in clearing U29.

8-249. As the counter is being stepped through the counts in the refresh mode, or any other mode, U3B continues to toggle with the clock pulses. This alternately enables and disables the counter. This allows the counter, which is clocked up with 8 MHz, to follow the Main Memory at 4 MHz. This process continues until U1's Carry Output goes high, once again. This removes the Low on U29A(1) and allows the next clock pulse to set the counter with the High on the D input.

8-250. Other elements on Sheet 1 are U27A and B, U29A, and U12, which control the refresh mode. U12 is a retriggerable one-shot. The Q output of the one-shot stays Low as long as it is being triggered by the two gated clock signals. Once these signals stop, the one-shot will time out 0.5 m5 later and the refresh operation will begin.

8-251. The Main Memory's phase 1 and phase 2 clock signals are generated by U5A and B, Q1, Q2, and U6. These devices are controlled by U13A. The circuitry to the left of the clock generators are associated with generating the mode control (serial or parallel operation of the Main Memory) and the two clocks for the 24-bit shift register. It is also used for multiplexing the data in and out of the memory.

8-252. U28B prevents the ROM or Main Memory from outputting data onto the Program Control bus. When U28A is clocked, it latches a data bit that indicates whether the program source is the ROM (Q=H) or the Main Memory (Q=L). U29B passes serial data from the Main Memory to the RAM on A5. Since the data is staggered in the memory, the operation for removing it is similar to that of entering it. The data is shifted through the shift register twice. One 12-bit word is read out on the first pass while the second word is temporarily ignored. On the second shift through the shift register, the second 12-bit word is read out.

8-253. A7 I/O BOARD BLOCK DIAGRAM THEORY OF OPERATION

8-254. The A7 I/O board (Figure 8-14) is used to interface, control, and format the data exchanged between the HP 9825A Desk Top Computer and the HP 5045A Digital IC Tester.

8-255. The A7 provides a standard HP-IB interface for these units. After the standard HP-IB handshake routine establishes that the 5045A is to receive (LI5TEN mode) or send (TALK mode) data to or from the 982SA, the A7 I/O board accepts the data from the initiating unit and formats the data for use by the receiving unit.

8-256. LISTEN Mode

8-257. When the A7 I/O board is in the LISTEN mode of operation data is being received from the 982SA and transmitted to the 5045A. A typical sequence of operation is as follows:

a. The information is loaded in from the HP-IB bus by specifying the letter "I" which initializes the address counter.

b. The data is then loaded into the Program Buffer Memory.

c. The Run Flip-Flop is then set by specifying the letter "R" and the data stored in the Program Buffer Memory is transferred to the 5045A Digital IC Tester.

8-258. TALK Mode

8-2S9. The sequence of operation for transferring data from the 5045A to the 9825A requires that a program first be loaded from the 982SA during the listen mode that will generate the data that is to be transferred back to the 982SA. The data generated by the S045A is then transferred via the serial-to-parallel converter and data selector to the Data Buffer or return address storage. When the A7 I/O board is set to the talk mode, this data is automatically transferred to the 982SA.

8-260. A8 PROM BOARD OVERVIEW

8-261. The PROM (programmable read only memory) board contains 36, 864 bits of fixed information arranged in 3072, 12-bit words (refer to A8 schematic). This memory stores the tester's basic operating routine. See Tables 8-6 and 8-7 of the information in hexadecimal and mnemonic operator form. The board is controlled by the 12 ROM ADD lines, the I/O ADDRESS line, and the $\overline{\text{ROM ADD CNTR XFER EN}}$ line. The three most-significant bits of the address lines are decoded in U23, which enables one set of three ROM's (along the horizontal plane of the schematic).

Figure 8-14. A7 I/O Board Block Diagram

8-262. Once a three-ROM set is enabled by U23, ROM ADD lines 2-256 drive the "A' inputs on the three devices, thereby, addressing a specific location within each ROM. The "0" outputs of the ROM's present their stored data to the output multiplexers, U8, U16, and U24. Each multiplexer will accept only four of the ROM's eight output lines at a time, as determined by the ROM ADD 1 line, which feeds the selected inputs. When the select input is a logical '0', the multiplexers select the first word, and select the second word with a logical "1". The selected bits exit the multiplexers as 12-bit Program Control words.

8-263. When appropriate, U7A and B and U15B act to force a logical "1" in Bit 11 of the Program Control word. This forces the Processor Memory (A5) to interpret any instruction on the lines as Data Entry/Exit or Logic Function/Computation rather than a RAM Address code.

8-264. The I/O ADDRES5 line inhibits U8, U16, and U24 when ROM addresses 0-15 are selected and the RUN I/O PROG (A9) lines are both active.

8-265. A9 ADDRESS BOARD OVERVIEW

8-266. The primary function of this board is set up ROM addresses. The ROM Address Register is comprised of U17, U20, and U12 (refer to A9 schematic). The register outputs a binary weighted, 12-bit ROM address code, which goes directly to the ROM board, A8. Under normal operation, the register's code increments with each gated clock pulse in a binary fashion. The PROGRAM ADVANCE line goes High for one clock pulse after the Data Location code is entered and again after the data is actually transferred (following the RAM Address code). If the address is to be changed by many counts, e.g., in a "GO TO" statement, the counter is preset with new address. This is done by pulling the register's LOAD inputs Low while the PROGRAM ADVANCE line is low and clocking in the new address code, which is presented serially on the RAM MEM OUT line. Notice that this line goes to the D_D input of U12. Once the first bit of the new code is clocked in, it is presented on the Q_D input. Following this output shows that is is connected to the D_C input. On the next clock pulse, then, the bit that was clocked in first will appear on the Q_C output while the second bit appears on the Q_D output. This left-shift technique continues until all 12-bits are entered when the $\overline{\text{ROM ADD CNTR XFER EN}}$ line goes High. The last bit entered is the most-significant bit.

8-267. Anytime the address is not being loaded and the Q_C and Q_D outputs are High, gate U4A is enabled and allows the multiplexers on A6 to select the Main Memory as the program source. Otherwise, the ROM functions as the program source. However, any time the ROM Address Register is being loaded with a new address (either advance or transfer), U2D is enabled and the resultant Low on the $\overline{\text{INHIBIT READ PROG}}$ line disables the A6 multiplexers from passing any data.

8-268. U5A, in the lower left corner of the schematic, generates the 8 MHz clock signal. U2A ANDs 4 and 8 MHz to give a 4 MHz signal with narrow pulses. This signal indirectly clocks the ROM Address Register. U15B divides the signal by two to provide a 4 MH signal. When the Main Memory is being accessed, it uses the 8 MHz signal; when it is being refreshed it uses the 8 MHz signal. U9A controls whether U11 passes the 8 or 4 MHz signal onto the MEM CLOCK line. U3A is also gated by U7B to pass the 4 MHz clock signal out to all boards except the pin drivers. This is the main data transfer clock.

8-269. When the instrument is first turned on, it is necessary to preset several circuits within the tester to some initial point, e.g., the ROM Address Register is reset to zero. The circuit that does this is R10 and C4, Q1, U10B, U16B, and their associated components. When the instrument first turns on, C4 conducts current rapidly and appears as a short to ground. This keeps Q1 turned off and allows U10B to clear U16B. The resultant High on the $\overline{Q}$ output pulls the $\overline{\text{RESET}}$ line Low through inverter U3B. Once C4 charges positive enough to turn on Q1, the inverter releases the Low on the CLR line. The D Flip-Flop sets on the next clock pulse, as a result of U1C(8) being High.

8-270. When the Program Control Lines contain a Data Entry/Exit Code that has a Data Location code of 15_8, it causes A4U23 to pull the $\overline{\text{EXT CNTL XFER EN}}$ line Low. This line disables U4B and causes U21 to perform a paralle load of control lines states available on its inputs. The state of these lines indicate the condition of certain peripheral circuits that are external to the CPU. Once the states are loaded, they can be clocked out serially to the A5 board, where the data bit will be placed in the RAM.

8-271. U13 (External Clock Input) is a serial shift register that accepts data from the RAM on the RAM MEM OUT line. Once the data is fully loaded into this shift register, it is clocked into U18, a buffer/latch device. This second device prevents data from rippling across the output lines as it is being clocked into storage. Once the data is shifted into U18, it is fed out as control lines for other circuits throughout the instrument.

8-272. A10 D/A AND PIN DRIVER CONTROL OVERVIEW

8-273. The main function of this board is to store the pin driver voltage and current information. This data is fed to the D/A converter, where it is strobed out to the appropriate pin drivers.

8-274. The Reference Level Storage circuitry is comprised of U6 and U12, which form a 2K shift-register memory (two parallel 1K memories). U18 controls the encoding and decoding of the information. To store data into the memory, the Processor Memory (A5) outputs this data serially to the serial input of U18. It then exits this device on the Q_C and Q_D outputs, which are connected to the D_A inputs on U6 and U12. The data enters the memory in a staggered format, much like the Main Memory. When information is later removed from the memory, it exits on the Q_C outputs and is parallel loaded into the D_A and D_B inputs of U18 via U5A and B. For the VI printout, data can be read out of the memory to the A5 board through U23B, U13F.

8-275. The memory runs at a slower rate than does the information being fed into it: U18 is clocked at a 4 MHz rate while the memory runs at 2 MHz. Actually, there are two clock signals that operate the register (Ø1 and Ø2). Each of these signals are 1 MHz and are out of phase with each other. The phases of the clock are generated by U7B, U11, and the outputs of U1 (Q_B) and U3 (Q_A). The signals are then level shifted by RC circuitry R30, R33, C6, C8, R19, CR3 and CR2 (clamps). When data is being read from the memory, U18 is in the parallel mode and the parallel clock used is 2 MHz (from U1 Q_A).

8-276. The Reference Level Storage has space available for 80 bits of information per pin. There are 24 valid pins plus one extra pin that is set aside as a "sratch pad"; in addition, there are some extra locations that are not used.Table 8-10 shows the data configuration for a given pin. U1, U2, and U3 form a Stack Counter which keeps track of the information in the memory. Although the memory is not regulated by specific locations, or addresses, the position of the data is known by knowing the total number of available locations and by selecting an arbitrary starting point and keeping track of that point. This starting point is defined by the overflow of U2. Notice that an overflow condition (U2 pin 15 goes High) causes U15B to preset the Stack Counter to a predetermined number (506). This absorbs the extra capacity of the counter which is not needed in this specific application. U1 is a decade counter, while U3 and U2 are binary counters. Starting at the left, then, and working across, the D inputs are weighted as follows: 1, 2, 4, 8 (but counts to 10 only) 10, 20, 40, 80, and 160, 320, 640, 1280.

8-277. A second counting circuit Pin Locator Counter is needed to assign groups of bits inside U6 and U12 as those pertaining to a specific pin number. This is done in U1, U4, and U17. U17 and D_D input of U4 comprise the Pin Number Locator. By loading the complement (plus one) of the pin number into this counter, the counter will overflow after it has been clocked by the same number of pulses as represents the pin number (e.g., pin 12 would require 11 clock pulses into U4D and U17 to produce an overflow). Since each pin represents 80 bits of data location in the memory, the Pin Number Locator must advance one pin number for every 80 clock pulses

because these pulses are also advancing the Memory and the Stack Counter. U1 provides a ÷10 circuit and the first three bits of U4 provide a ÷8 circuit, together they form a ÷80 prescaler for the Pin Driver Locator.

8-278. An example of the entire sequence would be as follows. First, the pin number data (in complement form plus one) is loaded from the Processor Memory (A5) into the Pin Number Locator circuit. This is done by enabling U9C via the $\overline{\text{D/A XFER EN}}$ line. The circuit is disabled from counting, however, due to the states of U16A and U22C. The circuit remains disabled until the Stack Counter overflows at U2(15), which signals the reference point. U16A and U22C release the disable level and all three circuits (Stack Counter, Pin Number Locator, and Reference Level Storage) begin counting. After 80 clock pulses pass, the Pin Number Locator is clocked once and the Reference Level Storage is at the beginning of the pin 2 data group. When U17 reaches the desired pin number, the counter overflows and outputs a READY FOR SETUP DATA signal. When the CPU is ready to input the setup data, it sets the $\overline{\text{DA XFER EN}}$ line Low, once again. This results in U9B(6) going Low, which clears U4 and U17 and enables U18 to accept serial data from the RAM. This setup data is stagger-loaded into the memory, U6 and U12.

Table 8-10. Setup Data Configuration

Bit No.	1st Group −I Source	2nd Group −V Source	3rd Group +I Source	4th Group +V Source
1	1 (MSB)	1 (M5B)	1 (MSB)	1 (M5B)
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9
10	10	10	10	10
11	11	11	11	11
12	12 (L5B)	12 (LSB)	12 (LSB)	12 (L5B)
13	ø	ø	ø	ø
14	ø	ø	ø	ø
15	−Gen Continuous	ø	ø	ø
16	−Gen Hi/Lo I	ø	ø	ø
17	Input	ø	ø	ø
18	+Gen Continuous	ø	ø	ø
19	+Gen Hi/Lo I	ø	ø	ø
20	ø	ø	ø	ø

8-279. Once setup data has been loaded for all pins, the data can be placed on the bus and strobed into the appropriate circuits. Refer once again to Table 8-10. The first 12 bits under each category of information (-I, -V, +I, +V) is the actual *Setup Data* word. This word enters the Digital-to-Analog Converter (DAC) on A11 and is converted to an analog level that will ultimately setup the value of a voltage or current source of a pin driver. This data leaves the board on pin 18 through 21 in the following manner: the first four most-significant bits enter the DAC in parallel, followed by the remaining eight bits which are sent in four 2-bit parallel transfers on the DELAYED 1 and DELAYED 2 lines. The remaining five bits of data (-Gen Continuous, etc.) are then clocked into U19 and are clocked into U24 after the three remaining reference levels are set up and as they transfer to the pin driver.

8-280. A11 REFERENCE LEVEL GENERATOR OVERVIEW

8-281. This board generates the reference voltages for the plus and minus voltage sources and the plus and minus current sources, located on the pin driver boards. (Refer to A11 schematic.) The board accepts four separate groups of digital data, each of which sets up a reference generator on this board. In order: —I, -V, +I, +V. The four reference voltages are fed onto a four-line bus that goes to all 12 pin driver boards. The reference generators are loaded twice for each pin drivers per board. The pin drivers are loaded sequentially, starting with A13 and ending with A24. This sequence is controlled by the outputs of U25A&B and U24B, which enable the specific pin driver board along with the odd pin and even pin strobe lines, which enable the specific pin drivers. As one set of voltages is being strobed out, another group of data is being converted into an analog level. This keeps the time between groups as short as possible. It also requires only one D/A converter; however, this system calls for two stages of sample and hold circuits.

8-282. The four most-significant bits of data are parallel loaded into U16A&B and U22A&B. The remaining eight bits of the data group are parallel loaded two bits at a time into shift registers U30A&B. The MSB is the sign bit (+ or -), while the remaining 10 bits determine the magnitude. The state of the L5B (available at U30A pin 13) controls some switching circuits, which are described later.

8-283. The outputs of the data latches are fed through buffers U23 and U29 and into a resistor ladder network contained in R76. The summation of this information is presented to one side of op amp U5, while U6 provides a 10.3V reference (3.4V at U5 pin 3) to the other side. The output level of U5 can now be entered into the first sample and hold circuit of the -I reference generator. This is done by holding the 5TROBE 5ETUP VOLTAGE High while pulsing the CLOCK 1 line at the same time. This places a High on U19A Q and enables the electronic switch, U21B, to pass the -I reference level from U5, through the buffer amps U20 and U21B where it charges the storage capacitor, C18.

8-284. Once this is done, the other storage capacitors in the remaining reference generators are set up in a like manner. The latches (U16A&B, U22A&B, and U30A&B) accept the next group of data and convert it into an analog level. The 5TROBE 5ETUP VOLTAGE line is set low and remains Low for the next three clock pulses of the LOCK 1 line (one clock pulse for each data group). The second clock pulse, then, will cause U19A $\overline{Q}$ to go Low, but before that can happen, this same clock pulse clocks the High present on U19A $\overline{Q}$ into the D input of U24A. This turns off Q2 and turns on switch U21D, which allows the -V level from U5 to charge C8. The third clock pulse causes U24A pin 12 to go High, which sets up the +I reference generator by enabling U21C and charging C16. The fourth clock pulse causes U24A pin 11 to go High; this turns off Q4 and sets up the +V reference generator by enabling U15D and charging C7.

8-285. The same line that enables the electronic switch U15D at pin 12 also enables, at the same time, switches U15C, U15B, and U15A, which allow the capacitors in the second sample and hold circuits to be charged; these are, respectively, C13, C9, and C29. During the time each group of data bits was being clocked into the first-stage storage capacitors, the least-significant bit of each group, available at U30A pin 13, was being inverted in Q13 and clocked in shift register U27. At the end of the third clock pulse, the least-significant bit of each of the first three groups is present on the outputs of U27. The LSB of the fourth group is present on the D input of U10A. These four bits are used to select the high or low operating range of the reference generators. When the fourth clock arrives, it enables the range selecting devices and also places the reference levels onto the bus. The setup of each generator is individually described below.

8-286. *-I Reference Generator* — U9A passes the level of U27 Q_C onto range capacitor C26, which enables or disables the range switch U9C.

8-287. *+I Reference Generator* — U9B passes the level of U27 Q_A onto range capacitor C25, which enables or disables the range switch U9D.

8-288. *-V Reference Generator* — The Q_B output of U27 is present on the D input of U10B. When fourth clock plse occurs, it clocks this level onto the Q output. The outputs of U10B turn on one of the range switches — U17C (low range) or U17B (high range). This same clock pulse also turns Q6 on and allows U8 to charge the secondary storage capacitor, C3.

8-289. *+V Reference Generator* — The LSB of the fourth group is present on the D input of U10A. When the fourth clock pulse occurs, it causes U24 Q_D to go High, and this clocks the level onto the Q output. The outputs of U10A turn on one of the range switches — U17D (low range) or U17A (high range). This same clock pulse also turns Q1 on and allows U7 to charge the secondary storage capacitor, C2.

8-290. A12 PIN DRIVER CONTROL OVERVIEW

8-291. This board controls several of the operations that are necessary just prior to testing of a device and, also, once the testing has started. The board supplies the '1' and '0' state setup data to the pin driver boards (A13-A24) and controls the strobing of that information onto boards. It also controls the fast edge circuitry on the socket driver assembies and the relay operation of the socket assembly. Finally, the A12 board examines the failure data returning from the pin driver boards to determine whether or not the device passed the test. (Refer to the A12 schematic.)

8-292. The six lines located at the upper right of the schematic control the strobing of information onto the pin driver boards. These are the TEST PATTERN/FAILURE STROBE lines and only one line is active at a time. They are driven by the 4-10 line decoder, U1B, which is controlled by the $\overline{\text{DATA SHIFT BIT 2}}$– lines. These lines are directly received from the Word Counter on the Processor Memory board, A5. As the '1' and '0' state setup bits serially enter U11, four bits at a time, the Word Counter on A5 increments its count as each bit is transferred, but U18 does not change state. The timing of the this circuit is as follows. On the first clock pulse into U13A, the $\overline{\text{DATA SHIFT BIT}}$ lines 2^0 and 2^1 go high. On the fourth clock pulse, all three inputs to U13A are low. This disables U13B and places a High on the D input of U1B. Since this device is a 4 to 10 line decoder the D input enables one of the upper two output lines, which are not used. This effectively disables the lower half of the device. At this time, the next four bits of '1' and '0' setup data are sitting on the outputs of U5 and are now clocked into U5 where they are presented to the pin drivers. The next clock pulse increments the three most significant $\overline{\text{DATA SHIFT BIT}}$ lines and, once again, enables U13B, which returns control to the lower half of U1B. This process continues until all pin drivers are loaded with '1' and '0' setup data.

8-293. When the test is initiated, a particular group of information is to be loaded in the Read/Write Memory, U2 when the test is initiated. This data designates which pairs of the device under test are inputs and which are outputs. This information is important because when testing begins, it will cause the fast edge circuits to generate a fast rise time when driving an input pin. In the case of an output pin, the fast edge circuits are not used and the output stage of the device, itself, controls the rise time. The data enters the board serially from the Processor Memory, A5, and is loaded into the D_A input of U6. There are six bits needed for each pin number. These bits continue being loaded into U6 and are shift-load, as a string, into U7. When all six bits are entered, the last bit entered appears on the Q_A output of U6 and is used as a select line for the multiplier, U1. The first bit entered appears on the Q_B output of U6 and is fed through U1 and is presented to either the D_A or D_B input of U2. The remaining four bit are present on the output lines of U7 and serve as address lines for U2. Once each group of bits has been setup, as described, the write enable (WE) input of U2 goes Low to store this data in a particular address of the memory.

8-294. After all the '1' and '0' state setup voltages are strobed into the pin drivers, pin 9 of U18 goes Low and resets the counter assembly of U7 and U6. Just prior to each test, clock pulses begin incrementing this counter. The outputs address the memory and pass the fast-edge data through the multiplexer and to the fast-edge circuits via U3D.

8-295. The A12 board also examines the failure data from the pin drivers. These line comparators of U15, U19, U16, and U20 and the levels are compared to a reference. T of the comparators are parallel loaded into U11. They are then right-shifted one bit at a ti to the clear (CLR) input of U10. If this line is High, it is interpreted as a failure; however, are examined for a failure during the test. The Processor Memory, then supplies data to designates whether or not a particular pin should be examined for failure data. This is acc on the D input of U10. If pin 12 is High, the tester will examine the pin for failure data state is then clocked into U10, unless the CLR input is being held Low, and is available output. The state of the Q output is the failure information: '1' = failure, '0' = no

8-296. At the beginning of the test, the Processor Memory, A5, is sending relay data to board via U3C and U3B. This data governs the closure of these relays. When closed, provide a ground for a particular pin on the device under test that is very near the pin. Th problems associated with long ground lines.

8-297. A13-A24 PIN DRIVER OVERVIEW

8-298. The Pin Driver board contains 5 major blocks of circuitry, as shown in the A13-A tic diagram. The first four are the positive current source, the "1" voltage source, the source, and the negative current source. The fifth block is the Gating Circuitry that c reference level generators' operation. These generators are configured to either drive ar an input or load and monitor an output of the device under test (DUT):

Input = "1" and +I or "0" and −I

Output = "1" and −I or "0" and +I

8-299. Electronic switches, control gates, and diodes control the various function generators. (This is represented in a simplified drawing of the generators, Figure 8-15, sh "1" and "0" voltage sources, with the current sources being listed as either +I or −I

8-300. The four reference lines from the Reference Level Generators (A11) are strobe Pin Driver board through electronic switches. Storage capacitors hold these referenc noninverting input (+) of each operational amplifier (op amp). The inverting side (−) of t is the *sense* side and monitors the same pin on the device under test as the pin driver drive.

8-301. As an example of driving an input, if the reference level and the sense level are amplifier is balanced and no failure data is generated. If they differ, the voltage source op into saturation and activates the failure line ('1' voltage source shows failure when it goe '0' voltage source shows failure when it goes negative). When a source is not being acti the gates and switches are arranged to balance the op amp.

8-302. Each current source has 3 CMOS gates that are drawn as negative input AND g one of these gates is enabled at a time, as controlled by the Gating Circuitry. When enabl amp output is transferred from the gate's VDD input (for the negative current source) to pin where it controls the current-pass transistor. Two of the gates select either the hi current mode (Low = 5 μA − 2.5 mA, High = 2.5 mA − 200 mA), and the third gate routes t output onto the sense line when that current generator is not being used to drive t

8-303. The two voltage sources operate in much the same manner as the current source cuit operation relies on a balanced op amp, which controls the drive voltage through a D transistor pair. When not actively used, the op amp remains balanced through an electron The RC time constant circuit ensures that the feedback switch and shunt switch are not on time during the transition. This ensures that the op amp has a feedback path while the changing.

enter the
outputs
e and fed
ot all pins
12 which
mplished
his logic
on the Q
ilure.

ıe socket
ne relays
prevents

schema-
voltage
trols the
monitor

of these
wing the

onto the
s on the
op amp
trying to

qual, the
mp goes
positive;
ely used,

es. Only
d, the op
s output
n or low
op amp
e DUT.

The cir-
rlington
c switch.
he same
tates are

PIN DRIVER MODE CONF
(Se